













THE  
EDINBURGH SCHOOL  
OF  
MEDICINE;  
CONTAINING THE  
PRELIMINARY OR FUNDAMENTAL BRANCHES  
OF  
PROFESSIONAL EDUCATION,  
AND  
ANATOMY, MEDICAL CHEMISTRY, AND  
BOTANY.

Intended as an  
INTRODUCTION TO THE CLINICAL GUIDES  
THE WHOLE FORMING A COMPLETE SYSTEM OF MEDICAL  
EDUCATION AND PRACTICE ACCORDING TO THE  
PLAN OF THE EDINBURGH SCHOOL

---

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---

IN FOUR VOLUMES.

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THE  
CHEMICAL GUIDE;  
OR, A  
VIEW  
OF THE  
MODERN PRINCIPLES  
OF  
MEDICAL CHEMISTRY, AND PHARMACY;  
ACCORDING TO THE ARRANGEMENT OF  
THE LATE DR. BLACK;  
WITH  
THE PHARMACEUTICAL PREPARATIONS  
OF  
THE LONDON AND EDINBURGH COLLEGES.



TO  
DR. WILLIAM SAUNDERS,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS  
OF LONDON, &c. &c.

*THIS Work, that details the Principles of a  
Science in which his Knowledge is eminently  
conspicuous, is addressed, as a proper Tribute  
to his Character and Talents, by*

THE AUTHOR.





## P R E F A C E.

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THE present volume, which contains the principles of Medical Chemistry, may be considered as divided into two parts. The first, or largest division, is composed from the Lectures of the late Dr. Black, introduced into this form, with the modern additions made to them, to adapt them to the use of the Student according to the present state of Chemical Science. In preserving the valuable collection of facts which distinguished the lessons of this illustrious Chemist, we conceive we are rendering a service of the highest utility to the interests of Science; for, if published, as originally delivered by him, with the obsolete theory, the Student would find it difficult to reconcile the difference of opinions with modern reasoning, and derive less advantage from their perusal than in their present form. The arrangement, therefore, of Dr. Black

has been scrupulously preserved; and to the end of each Class we have subjoined a view of the Medical Effects of the different Substances that compose it in one connected detail.

In this part we have had occasion to treat, at large, the various Airs as Medicines, and to appreciate their relative importance.

In the second class, Mineral Waters form an important detail. Under the Salts, the late introduction of the Acids as anti-venereal remedies has been fully reviewed; and, in the Metals, the same consideration of their Medical properties has taken place.

The principles of Vegetable and Animal Substances, and the functions of the Animal system, have received equal attention.

In the last part, or Pharmacy, is introduced the mode of exhibiting all the remedies of the former classes, or divisions; and to the Pharmacopœia's of the two Colleges are added the exhibition of Airs and the artificial Preparation of Mineral Waters. We have considered ourselves not at liberty in the first part to alter the manner of Dr. Black, but have scrupulously adhered both to his style and expression, for which no apology is, surely, necessary. To this illustrious chemist the modern discoveries

may be considered as owing. The discovery of the first of the gaseous bodies, or carbonic acid gas, so eminently his own, led the way, and required only an extension of what his well-conducted experiments first suggested.

On the whole we flatter ourselves, that the present volume, with the separate Pharmacopœia's of the Clinical Guide, will abundantly detail what is necessary for the Student to know on the subjects of Medical Chemistry and Pharmacy.





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# HISTORY

OF

# CHEMISTRY.

---

## I.

**CHEMISTRY** is that science which contributes more than any other, to the utility, the ornament and pleasure of Society.

## II.

its comprehending all the effects of heat, light, air, and mixture on bodies, its subject includes every substance whose form renders it capable of being acted upon by these powers. Hence it takes in almost the whole of creation, and from the nature of its subject, an ultimate knowledge of the science can never be attained, nor the reach of its discoveries bounded.

## III.

The origin of Chemistry, like that of all the other sciences, is obscure, that many parts of it must have been very early known cannot be doubted. In their natural state numerous bodies are exposed to the effects of heat, light,

air, and mixture: and though the principles of these effects or changes could not then be explained, yet mankind, from repeatedly examining such effects, would naturally be led to imitate them, and by accident would sometimes attain what they aimed at. Thus, a foundation for many parts of this science, would come to be very early laid. There is therefore no need for endeavouring to support its antiquity, as authors have done, by any fanciful proofs, a contested point which involves no real utility.

## IV.

In pursuing the History of Chemistry the circumstances necessary to be attended to are,

1st, The different views of its followers at different periods, and which led of course to a different state of the science.

2dly, The celebrated persons by whom these different states were produced.

And, 3dly, The periods of time as connected with the general history of mankind, when these different states or revolutions in the science took place.

## V.

Proceeding then on this plan, three different periods fall to be remarked in the History of Chemistry, at each of which a considerable change in its views occurred.

## VI.

The first of these periods extends from its origin, or from the first accounts of the science, until the time when, presuming on the power of their art, chemists attempted a transmutation of the baser metals into gold, which became for long the favourite object of this science.

## VII.

The second period to be remarked is from the time

chemists, laying aside this idea as impracticable, applied their attention to medicine, and attempted the discovery of a Panacea, or universal remedy.

## VIII.

The third period commences from the time that chemists failing likewise in this favourite object, Philosophy came to be introduced into the science, which modifying the views of its followers, gave it a new face, such as it wears at the present day, when it is dedicated to the improvement of the essential and ornamental parts of life.

## IX.

These then are the chief periods to be fixed in the History of Chemistry, and those celebrated authors fall next to be mentioned to whom the science is chiefly indebted for the alterations which took place in it at these periods, and who therefore in studying the subject deserve principal regard.

## X.

The author or name to be noticed at the commencement of the first period, is the Hermes or Mercury of the Egyptians, who is reputed to have taught many of the arts to that people; and the conclusion again of this period was marked by the name of FRISI Bacon; for though a number of others preceded him, yet none of them have been so celebrated as this last author.

## XI

The second extends from Roger Bacon to the age of Paracelsus, who may be said properly to have been the first medical chemist, and to whom we certainly owe the introduction of many powerful remedies.

## XII.

The third is from Paracelsus to about the commence-



ment of the present century, which we shall mark by the name of the great Sir Isaac Newton.

4

## XIII.

The fourth is from the time of Sir Isaac Newton to the present day, which we shall close with the name of the illustrious and unfortunate Lavoisier, who may be considered in chemistry as having created a new science.

## XIV.

Of the first, or what we may term the casual state of chemistry, little is to be depended on. That some arts were early known, there can be no doubt; but on this chemists, to support the antiquity of their science, have presumed a great deal; conjecture has supplied the place of history, and, if we can credit authors, most of the great men who flourished in antiquity, were more or less adepts in this kind of knowledge; the traces of it, however, to one who impartially peruses the subject, are very faint. It appears indeed that metallurgy, or some notion of the separation of metals from their ores was very early known; that the tinging different stuffs with colour, or the art of dying, had also made some progress; and that even the making of glass, was an art not unknown in the days of Pliny; but still this amounts to very little, when tracing the History of Chemistry as a science; and even those few arts that were known, we may judge would be in a very rude state at that period.

## XV.

Chemistry then may be said to have taken its first regular form at what we have marked as the second period of its history, when the object of its professors came to be the transmutation of the baser metals into gold. This æra may be named properly the Superstitious State of Chemis-

try. It began about the time of Constantine the Great; and indeed we have no writers upon it any higher than the period of the translation of the Roman Empire to Constantinople. For though the metallurgic part of chemistry, as we observed, is found very ancient, and most of the first writings on the science are confined to this division of it, yet it was not until this late period that alchemy became its professed object. The first author who wrote expressly on this art is Julius Maternus Firmicus, and soon after him Æneas Gazæus, who mentions it as a process, the success of which was then beyond dispute. To the first cultivators of this science, indeed many of the changes that took place on matter, during their operations, would appear astonishing: hence they would be liable to overrate the power of an art, whose principles were yet in their infancy. They lived too in an age when superstition tainted every department of science, and when the mind, visionary and wild, runs generally from one extreme to another, without pursuing the sober tract of philosophical investigation. It would appear that chemists at this time, though unsuccessful in this attempt of transmutation, had yet inculcated the universal belief that they were possessed of the means of doing it. Hence, we find a decree of the Emperor Dioclesian, that all the writings of the chemists of Egypt should be burned; which country had at that time rebelled against his government. By this means he supposed the Egyptians would be deprived of their knowledge of preparing gold, and then be rendered unable to support the expences of war. To confirm this, the writings also published by the chemists were generally in a language peculiar to themselves, and this affected obscurity encreased the apparent value of their con-

ments. The theory at this time, on which they proceeded, was that gold was the only perfect metal, that the others were only essays towards it, which required a finishing hand, and which they therefore, in imitation of Nature, attempted to accomplish. In doing this, though it appears they missed their aim, yet they certainly fell on several great discoveries, and which, instead of failing as they should have done, they considered only in a secondary way, or as so many steps towards their success in their favorite pursuit. The value indeed of most subjects, on which we have bestowed much labour and attention, we are apt to estimate too high, and to consider probabilities as too nearly allied to realities. Thus we find that even the philosophical mind of Mr. Boyle, and also Boerhaave himself, was not proof against this weakness. They both consider the power of chemistry as adequate to the formation of gold. Even later, an English Physician Dr. Price pretends to have actually succeeded in the experiment, and that before a number of most creditable witnesses. But as his experiment was never carried farther than in the small pamphlet he wrote, and as it said that, before his death, which happened soon after, he repented of what he had published, we have every reason to infer there must have been some fallacy in the case. At any rate we may conclude that, after the experiments of so many ages, we have yet no process for procuring this change; and if any chemists have accidentally succeeded in any instance, as they pretend, they have never yet brought it to that perfection as to render it universal.

## XVI.

From this superstitious or alchemical period of chemistry, we proceed to the next or the medical. Until the

introduction of chemistry into medicine, the remedies employed were few in number, and at the same time simple in their nature. ~~On~~ its introduction a remarkable revolution arose to which many circumstances contributed. The era of this revolution may be placed about the year—— for though many chemical medicines were employed by the Arabians, as we find from the names of them still retained, yet, until this period, or the age of Paracelsus, medical chemistry did not become general. The circumstances which contributed to render this revolution so remarkable were,

1st. The progress of anatomy detecting the errors of the ancient physiology, on which the theories of the schools were formed: and, secondly, the appearance of certain new diseases at this time, resisting the efficacy of the Galenical practice.

## XVII.

The author to whom we are indebted for the first of these, was Vesalius. This anatomist, the greatest of his age, by substituting the human subject in the place of the quadruped, the common anatomical victim of these days, publicly detected the errors of Aristotle and Galen, whose reputation on medical subjects had been hitherto deemed infallible in the schools. The veneration for antiquity being thus shaken, a revolution was easily effected; for the venereal disease being at this time brought from America, and every where spreading its devastations, the physicians were unable to check its progress by the use of the common Galenical remedies. It was here the genius of Paracelsus shewed itself. Being acquainted with the properties of mercury, which it is said he had learnt from an eminent surgeon of that time, named Carpi, he

boldly applied it in the cure of this disease, and that with such success as to become the first practitioner of his day. Opium also he got acquainted with; and by the use of these two very active medicines, with a bold and daring hand, he effected cures surprising in an age when the remedies employed, if not weak and inert of themselves, were at least rendered so by the small quantities, in which, according to the Galenical practice, they were exhibited. Naturally of a heated imagination, his success with these medicines, in the diseases to which they were properly applied, carried him too far, and he expected, by means of chemical remedies, to remove every malady to which the body is subjected. With this view, a chemical theory of medicine came to be introduced by him; but in spite of his boasted Panacea, which was to answer every purpose, and with which he promised to extend his own life to at least a hundred years, Paracelsus died at an early period. Succeeding chemists, we find, enter into his views, in their attempts at an universal medicine; and Van Helmont goes so far as to promise even an antidote against fate. It must be confessed, however, that to the chemists, although thus visionary in their ideas, a knowledge of many powerful remedies is owing; and from this time until very lately, physicians came to be divided into two sects, the Galenical and Chemical; the former adhering to the old opinions of the school, and the latter embracing the new doctrines of chemistry.

## XVIII.

But though we thus allow the merit of chemistry to have been great, in leading us to an acquaintance with many powerful remedies, yet the connection of its principles with physic, has certainly, on the whole, been a prejudice to the latter.

For, 1st.—By the introduction of chemistry into medicine, a wide field was opened for empiricism from the facility with which remedies were invented, and at the same time the nature concealed: And, 2dly. The action of every remedy being explained on chemical principles, those powers which regulate the animal œconomy were lost sight of, and the operation of the vital principle subjected to the laws of inanimate matter; and it is only within these few years that the chemical tenets of medicine have been exploded, though an attempt is now made to revive them in a new form.

## XIX

We come now to the third and last æra of chemistry, or what we have termed the Philosophical. Hitherto its professors were occupied solely with the pursuit of one object, and the bounds of the science were thus contracted within the narrow limits of an art. It is at this period we come to view it in a proper light, when the chimerical extravagancies of its votaries being given up, it came to be applied to the improvement of the arts, and the advantage of civil life. The æra of this change is so late as the year——; and hence it may be properly said to have been the last of the sciences that emerged from barbarism, or put off the rude garb, in which it had formerly appeared, for the charms of philosophy. The author to whom we are indebted for this change, was Bacon Lord Verulam. Fond of philosophy, and the study of nature, he took a view of the different sciences, observed the progress which had been made in each, and marked out what remained to be done. He saw that chemistry, however rough in her appearance, by extending her views, might be made one of the most useful branches of science. His example was followed by the Honorable Mr. Boyle, who both

improved chemistry himself, and also with much freedom detected the errors of preceding chemists. Sir Isaac Newton likewise contributed much, to place it upon its present footing; and his discoveries have opened a way to the improvement of every department of science. The universal taste for literature which at this period prevailed, naturally suggested the idea of literary institutions for the improvement of knowledge, and the free communication of discoveries; in consequence of this, the Royal Society of London came at last to be established: the same plan was soon followed by the French, and in the course of a few years, similar institutions became general in every country in Europe. To these institutions has chemistry perhaps owed more than any of the other sciences, and the patronage of different Princes has of late years increased much the ardour for chemical pursuits. Convinced of the advantages to be derived from the cultivation of this science, a liberal support has been afforded to its enquiries in those countries, especially where minerals abound; and thus chemists of the first eminence have appeared in France, Germany, Sweden, and even Russia. New discoveries, therefore, it is to be hoped, will daily increase the value of the science, and widen its circle beyond any bounds that can be set to it.

## XX.

Such are the principal aeras that deserve to be remarked in the progress of chemistry to the present day; and from this view, Philosophical Chemistry, or the Science in its present state, comes to be properly divided into two departments, the Medical and Commercial: the former of which only is the object of the present work; and the principles of chemistry therefore we are to consider here as applied to medicine alone.

## INTRODUCTION.

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**C**<sup>I.</sup>**H**<sup>I.</sup>**E**<sup>I.</sup>**M**<sup>I.</sup>**I**<sup>I.</sup>**S**<sup>I.</sup>**T**<sup>I.</sup>**R**<sup>I.</sup>**Y** is that science which, teaching the effects of heat, light, air, and mixture on bodies, detects their constituent principles, their qualities and combinations.

### II.

For the purposes of science, all bodies require to be arranged into certain classes; and this arrangement may be formed either, first, from their origin, which is from the Vegetable, Fossil, or Animal Kingdoms.

2dly, Their most simple state as composed more or less of elementary principles.

Or, 3dly. Their natural qualities as being saline, inflammable, metallic, earthy, watery and aerial.

### III.

The last of these arrangements, as preserving the natural connection of bodies, is to be preferred; and as all matter is retained in its natural state, by a certain connection of its particles to each other, termed their cohesive attraction according to the weakest degree of this in each, the order of their arrangement should be placed viz. Airs, Waters, Inflammables, Salts, Earths, Metals.



## INTRODUCTION.

## IV.

Airs are fluids highly elastic in every degree of temperature yet known.

## V.

Waters are colourless, insipid bodies possessing a disposition to unite with salts and some airs.

## VI.

Inflammables are such substances as, when set on fire, burn until resolved into their constituent parts.

## VII.

Salts are distinguished by their capacity of uniting, with or solubility in water, their sapidity as affecting more or less the organ of taste, and in general their want of inflammability.

## VIII.

Earths are somewhat unctuous, miscible in water, but insoluble, and resisting the action of fire.

## IX.

Metals are the densest and heaviest of bodies, fusible in fire, and malleable.

## X.

By the principles of chemistry, then, the nature and qualities of these bodies defined (from IV. to X.) come to be detected, but previous to their application for this purpose, the general mode of action of these powers requires to be explained.

## XI.

I. *Chemical Powers.*—*Heat.*

By heat is understood a peculiar sensation or feeling excited in our organs, arising from a particular state of the air around.

## XII.

The Phenomena to be remarked in this state of the bodies, is a certain motion of their particles on each other, which continues so long as the feeling they impress remains.

## XIII.

This state which bodies acquire, possesses always a tendency to leave them, or to communicate itself to those contiguous ; and this communication produces at last an equilibrium between the surrounding bodies, which gives to the whole an equal temperature.

## XIV.

This temperature to which bodies return, when heat forsakes them, or when they are incapable of exciting in our organs the same sensation as before, we term cold.

## XV.

Cold seems the original state of bodies, and though many arguments have been used to support, on the contrary, its activity by the existence of certain particles, termed Frigorific, yet, as there is no cause from which cold proceeds, but the bare absence of heat, and as their frigorific particles appear rather a particular arrangement of the particles of certain bodies, under peculiar circumstances, the proofs of it adduced are inconclusive.

## XVI.

By cold is understood every degree of temperature, inferior to our own, and which is incapable of exciting the same sensation communicated by heat ; but as bodies of the same degree of temperature excite opposite sensations in different individuals depending on this degree of their own temperature, so cold seems only an inferior degree of heat, measured by our own feelings. Hence, accord-

ing to the degree of those opposite sensations, excited in ourselves, we judge of the various degrees of temperature prevailing in bodies.

## XVII.

Since heat then, from what was observed, discovers always a tendency to leave bodies, we must conclude that it is not their natural state, but a property acquired, and the different means of acquiring it may be referred to the head of motion, mechanically, or chemically excited.

## XVIII.

From a consideration of the causes inducing heat, two theories respecting its nature at present prevail, termed the "Mechanical and Chemical. The former supposing it to consist solely in a certain rapid motion of the particles of the bodies upon each other. The latter, as depending on a peculiar elastic matter originally present in them, but rendered active by motion.

## XIX.

Adopting the latter of them, heat may be defined "A subtle, elastic fluid, the particles of which, in proportion as they possess a strong attraction for the particles of other bodies, display a repulsency or repulsive disposition between their own;" and this fluid is termed caloric, or the matter of heat.

## XX.

This disposition is discovered by the effects of heat, which on all bodies are pretty similar, and consist in their expansion, fluidity, vapour, and inflammation.

## XXI.

*Expansion.*

Expansion is an increase of the bulk of bodies propor-

tioned to the increase of the matter of heat, and which supposes their consequent contraction or return to their natural state on its removal.

## XXII.

All bodies appear under three distinct forms of *Solid*, *Fluid*, and *Elastic Fluid*. According, then, to the different cohesion of their particles, the quantity of this expansion differs with the same temperature in different bodies, the proportion being less in the first, greater in the second, and most of all in the last, though the exact degree of it in each have not yet been precisely ascertained.

## XXIII.

According to the nature of the bodies, and the different purposes also for which it is intended this effect of heat should be differently induced, for in those of a rigid and inflexible kind, the sudden application of it by acting partially occasions their rupture, and the same occurs to a heated body suddenly reduced in its temperature by the application of cold, yet in some cases, where a sudden contraction of the expanded body is required, this procedure is necessary.

## XXIV.

Though expansion is thus the general effect of heat, and contraction, on the contrary, arises from cold, yet in certain cases, where by the change of temperature a new body is formed, expansion is produced by the latter. Thus water, when formed into ice, is more bulky in its parts, and iron, and some other metals acquire, on cooling, a more expanded form, in consequence of their changing into a more brittle state.

## XXV.

By the expansion, however, which bodies receive from the power of heat, nothing is added to their weight. This is in those particular cases where they receive an evident change of their original texture. Thus metals turned to ashes weigh heavier than when in the form of the metal.

## XXVI.

But though bodies receive no additional weight from this effect of heat, a considerable difference in regard to their specific density in their relations to each other is produced.

## XXVII.

It is from this effect of heat on bodies, that different attempts have been made to ascertain its increase or diminution, in a more accurate manner than can be done by the standard of our own temperature or the feeling it conveys. These are termed Thermometers, and consist of different fluids enclosed in a tube accurately formed in its dimensions, or capacity, and hermetically sealed. These fluids have been either spirit of wine, mercury or linseed oil.

## XXVIII.

In the construction of thermometers, three circumstances are necessary to be attended to, in order to render them accurate.

1st. The first is, that the containing substance or tube be formed of a matter receiving the impression of heat equally in every part; and that the fluid also should be visible in it; and for this purpose glass is preferred.

## INTRODUCTION.

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2d. The second is, that the fluid employed should be easily and regularly expanded; and mercury is with this view more generally employed.

3d. And the third is, that the exclusion of air, or the vacuum be complete on introducing the fluid, and that no evaporation afterwards take place.

### XXIX.

With attention to these circumstances, the thermometer is formed by first establishing certain fixed points, in order to form a regular scale. These points are three, the point of melting snow, the point of boiling water, and the intermediate point of temperature, betwixt these two. These points being once established, all the other gradations can be easily settled.

### XXX.

A thermometer so constructed may be trusted as measuring with accuracy the regular standard of heat in bodies, to the extent of the points specified, but beyond these the use of thermometers is limited, as in very high degrees of heat an irregularity in the expansion of the fluid takes place, by which high degrees of heat cannot be measured by it, neither is the thermometer able to ascertain the proportion or intensity that one heat bears to another.

### XXXI.

The first of these defects, or the measure of high degrees of heat, is supplied by calculation. Thus a red hot iron being taken from the fire, and allowed to cool until the thermometer can be applied to it, if the degree of heat then present in it is measured, and the exact time ascertained it required to arrive at that point or degree, a calculation of its former heat may be made.

## XXXII.

The thermometers of different countries are formed on various scales; and, in order to be acquainted with these scales, the thermometer is to be tried by fixing the three points formerly specified. The thermometer most commonly used in Britain is that of Fahrenheit, which, between the points of boiling water, and melting snow, is divided into 180 degrees; but later discoveries having carried the degree of cold farther than the point of melting snow, a descending series is also marked of 32 degrees, which is termed below nought.

A smaller thermometer is also in use, having its points fixed at that of melting snow, and of animal heat, the intermediate gradations being divided into 64 degrees, and the point of animal heat fixed at 96.

## XXXIII.

*Fluidity.*

Every degree of heat capable of exciting the particular sensation described, (XI.) produces expansion, but fluidity the next effect of heat, occurs only in a certain high degree of it, and is always to be considered as a certain consequence of its presence.

## XXXIV.

This degree necessary to produce fluidity, varies much in different bodies. Every degree, however, below, or in which the body retains its solid form, is termed the Point of Congelation. When the heat again is thrown in, to a certain degree, so as to loosen the cohesion of its particles, and occasion their consequent softness, it is named the

Point of Melification ; and when actual fluidity begins, it is called the Point of Liquefaction.

## XXXV.

Every body, however dense, may, by the action of heat, be reduced to a fluid state, and on the contrary every fluid however rare, may, by cold, acquire a solid form ; For the difficulty of giving solidity to certain fluids, appears to depend on the difficulty of extricating their latent, or original heat, termed their Combined Caloric, which, according to their rareness, requires a more continued and intense application of cold.

## XXXVI.

The effect of this fluidity on bodies, on the removal of the sensible heat or free caloric inducing it, consists in producing in them a state of fusion, vitrification, and scorification. By the first of which is understood, when bodies display the same appearance on congealing they formerly possessed. By the second, when they are changed by it into a matter resembling glass. And by the third, when they form merely a composition of the original matter.

## XXXVII.

*Vapour.*

From fluidity, by a still higher degree of heat, bodies are next converted into vapour, or an elastic fluid, rarer and lighter than air ; and when reduced again in their temperature below this degree, they return to their natural state.

## XXXVIII.

This degree, termed the Vaporific Point, is different in different bodies, and is not so steady as that of lique-



faction ; for, independent of heat, pressure seems like with to have an influence on this change. Thus, in proportion to its application, bodies are capable of bearing a greater degree of heat ; and as it is taken away, they are sooner converted into this state. This difference also, or degree of the vaporific point, depends on the nature of the bodies themselves, and the capacity they possess of receiving this alteration. Hence, a division of them from the degree of heat requisite for converting them into vapour, has been made into the volatile, and fixed, in the former, the conversion being easy in the latter from their greater solidity, more difficult.

## XXXIX.

The theory on which the generation of vapour termed boiling or ebullition depends, has much divided the opinions of chemists. We suppose it to arise from the accumulation of such a quantity of sensible heat or free caloric, that no more can enter without converting the fluid receiving it into vapour, and the lowest parts of the fluid receiving this conversion first, they naturally ascend, or are thrown up to the surface with violence, which successively takes place until the whole is exhausted.

But besides this, certain circumstances occur in the process which shew that, independent of the sensible heat, or free caloric, an accumulation of latent heat, or combined caloric, also takes place, and enters into the vapour as an ingredient in its composition, being again extricated on the bodies returning to a different form. This appears by no increase of heat apparently taking place after ebullition begins, though a considerable time elapse before the process is finished, and by ebullition always taking place at the same degree, whatever

the form of the vessel & in which the conversion into vapour is made.

## XL.

This change in general requires, we observed, a higher degree of heat than that necessary to fluidity; and all bodies however fixed may be volatilized or receive this form. The change is always to be understood as the consequence of heat, either sensible or latent; for, independent of the application of sensible heat, that is, of caloric either free or combined, all bodies, from the possession of their latent quantity, or free caloric, or combined caloric, are constantly receiving a dissipation of their more volatile parts; and this is particularly the case in those substances in which the volatile parts are in great abundance.

## XLI.

Hence, a division of vapour may be made into the partial or spontaneous, and into the elastic, or general; the former being performed in a gradual, slow manner, and insensibly taking place; the latter being quick in its operation, and having the same action on every part of the substance, which it displays by its total dissolution.

## XLII.

The former, or spontaneous, is particularly exemplified in the case of volatile bodies, which constantly emit an effluvia, and also in water, in which a constant evaporation on exposure takes place; and this evaporation appears inelastic, and is confined entirely to the surface; hence, the larger the exposure, the greater this evaporation is experienced to be. It is to this cause the origin of damps and fogs is to be attributed. The presence of the sun occasioning this spontaneous evaporation, which is again

on its absence, converted into this particular form. By this also, the cause of hoar-frost may be explained, and the human body also, from the same spontaneous evaporation, is enabled to bear the excessive heat of warm climates. The surrounding atmosphere is tempered by the evaporation of its fluids, and a cause thus opposed to that exciting the animal heat within; and it is perhaps the want of this evaporation that occasions the excessive heat in fever, in consequence of the constriction of the skin, and the lessened discharges which attend it.

#### XLIII.

The elastic evaporation again depends on the application of sensible heat or free caloric; and this application receives various denominations, according to the purposes intended, or the different volatility of the substances separated. Thus, when the volatile parts are separated, and again condensed into a solid or fluid form, this process is termed Sublimation and Distillation. When the fixed parts only are preserved, it is termed Evaporation and Ussulation.

#### XLIV.

##### *Ignition.*

After vapour the next effect of heat that falls to be mentioned is Ignition. This effect is universal, and all bodies undergo this change, even the most elastic, if their elasticity is capable of being confined.

#### XLV.

The exact degree at which this change takes place, is more uniform than that of all the other effects of heat, and in all bodies it is the same; but this degree can only

be ascertained by calculation, for it goes beyond the limits of the thermometer to settle it.

## XLVI.

Different degrees of this effect of heat, are taken notice of both by chemists and mechanics, as melting red hot, melting when beginning to be red hot, and melting after being red hot, also a cherry red, a worm red, &c. and there is no doubt that this effect of heat can be increased to a considerable degree beyond bare ignition: in this it differs from ebullition, which remains always the same.

## XLVII.

Now with accuracy these different degrees which ~~fires~~ <sup>are</sup>, in order to produce on bodies its general effect, have hitherto been considering, we shall next enumerate them, as stated by Fahrenheit in his thermometer. — *Vide Fahrenheit's Scale.*

## XLVIII.

*Inflammation.*

The last, though a less general effect of heat than any of the former, is Inflammation. It is an effect confined to a particular set of bodies, or the inflammable, and this effect in them is attended also with certain changes, different from all other bodies, which receive from heat no permanent alteration, and only communicate it to the bodies around.

## XLIX.

The phenomena of inflammation in such bodies consist on their being once heated, in its continuing and acquiring strength, so that they give out much light and

heat to those around. When this effect comes to cease, they then appear, on examination, changed in their nature to a substance similar to other kinds of matter, and the source of light and heat, they formerly possessed no longer exists.

## L.

This matter, into which they are changed after combustion, varies in different bodies. The spirit of wine is changed into water sulphur into a salt, and others into an earthy matter, &c.

## LI.

The cause of this peculiarity of inflammable bodies depends on their strong attraction for vital air, in a certain temperature, and their combination with it, which occasions the production of all the phenomena of combustion and the subsequent changes that ensue.

## LII.

This peculiarity of inflammable bodies is all the foundation of other properties they possess, they generally encrease their disposition to fluidity, and volatility; and in many bodies where there is a less degree, they to convey inflammability, it gives them other properties.

## LIII.

The degree of heat necessary to produce this effect on bodies, varies in different cases, but a certain degree of it is always necessary, and along with this also, the contact of the inflammable body, with the atmosphere, and even the frequent renewal of the latter, are essential circumstances, in order to its sufficient absorption of vital air.

## LIV.

Thus we have traced the general effects of heat, or that power which is the chief internal cause and principle of activity in the universe. Its presence we find every where. By it the principal operations of nature are carried on. From the ocean the water is raised by it, which descends again in the form of rain, in order to support all animal and vegetable life. To the latter it gives the power of attracting nourishment, which it refines in the different parts of the vegetable, so as to make it assume the different forms, which its different forms take; and when its influence departs, the decay and death of their structure ensues. To animal life it is equally necessary; by it alone the evolution of the egg is enabled to take place, and that independent of the female at all. When the embryo is afterwards complete, the same dependence is still necessary for its support, and when this power is removed, torpor, and insensibility occur, and the scale unto which it once expired. This is a common phenomenon in northern countries, where extreme cold pre-

Thus the face and appearance of nature, the very form in which the different parts of it assume, depend upon the nice adjustment by which heat is regulated. Water alone, which we see in so many beautiful forms, moving with fluidity and transparency, when regarded with a philosophical eye, we find also employed in the most extensive operations of nature, pervading the most interior parts of the earth, necessary to the protection of various minerals, stones, and earths, assisting in bringing their different ingredients together, and making them concrete. When we examine it farther, in the form of vapour, we

see it rise from the surface of the ocean to form clouds, which descend in rain on the land ; on other occasions, these clouds form snow, to protect the vegetables from intense and mortal cold ; and after this change, by the heat of summer, it returns to its former state, and descends to promote vegetation, and to bring every thing to maturity. Such is its multiplied and extensive use, when set on motion, and directed by the nice adjustment of that heat, which attends the return of day and night, of summer and winter, and which occasions also the different forms it assumes in different parts of the globe ; for the proper heat being withdrawn, it acquires a solid appearance, and becomes unfit for the various operations described. On the other hand, if the heat exceed its due degree, it is changed into vapour, and thus the solid parts of the globe, would be confounded ; and by the mixture of air, water, smoke, and vapour, the original chaos would take place.

## LV.

2. *Light.*

The 2d chemical power we enumerated after Heat, is Light.

By Light we understand that sensation or feeling impressed by radiant bodies on our organs, which occasions the perception of sight.

## LVI.

The phenomena remarked in such bodies producing light are, that it is projected from them in every direction; that it is reflected in right lines, and diverges in proportion as it proceeds from its source ; that it is emitted with instantaneous velocity ; that it becomes inflected as it passes near any substance ; and that when it fully enters it, it suffers refraction.

## LVII.

By this sensation of light, we are enabled to distinguish the presence of bodies, and to divide them, as opaque, transparent, and coloured. This depends on the different rays of light, and the various modifications they receive when applied to bodies.

## LVIII.

The different rays of light, or primitive divisions of it, are demonstrated to be seven; red, orange, yellow, green, blue, indigo, and violet; the first being the least refracted, and the others refrangible in their order. Hence, it is to the different combinations of rays, reflected from the surface of bodies, that all the different shades of colour are owing.

## LIX.

The general source of light we find to be combustion or attrition, and from this is inferred its supposed connection with heat; but that a distinction takes place between them appears,

1. Because heat, as in fire, is not proportioned to the light it gives:
2. Light is often fugitive, but heat is always more permanent:
3. Heat, with access of air, produces combustion; light has often an opposite effect.

## LX.

The effects of this power are important, and chiefly displayed on Vegetation.—To it the colour and odour of vegetables is to be greatly attributed; and it likewise exalts in a high degree their powers in other respects. Thus plants growing in the shade are pale, and without color.



Thus the warmer climates afford productions of more exalted smell and taste. By light vegetables are enabled to pour out torrents of pure air, and to correct the state of the atmosphere which surrounds them. To chemistry its effects are equally important. There is not a substance but receives some alteration from its exposure to light; alterations which have not as yet been sufficiently attended to, but which open a wide field for future research.

## LXI.

3. *Air.*

The 3d chemical power to be noticed after Heat and Light is Air, a power of universal agency, and which owes the detection of its general influence to modern discovery. As the consideration of this power occurs in almost every process, and as the whole of chemistry depends on the extrication or fixation of this fluid, it is improper to enter into any farther detail of it here.

## LXII.

4. *Mixture.*

From the consideration of these different chemical powers, we proceed to examine the last, or Mixture.

The effects of mixture on bodies, are more varied than those of heat, and are therefore less capable of being reduced to a general application.

## LXIII.

The first effect of mixture is, its being attended either with union, or without union; and this union is either slowly and gently performed, or with heat, agitation, and even violence.

This union is either of two fluid bodies together, or at

other times of a solid and fluid. It is also attended either with active solution, or merely diffusion; the fluid body being termed the solvend, or menstruum, and this solution in the latter, or menstruum, only takes place to a certain proportion of the solid body, which is termed saturation.

This saturation is of two kinds, the simple and the reciprocal, which refer to the proportion of combination that takes place.

## LXIV.

But bodies thus mixed, we occasionally wish again to separate, and to do this the two powers required are, heat, and the addition of a third body.

With respect to heat, the degree of it required is often different on the mixture from what it was on the separate substance.

In regard to the addition of another body, when the mixture has consisted of a solid and fluid, the separation from the one falling down in a solid form, is termed precipitation, and the body occasioning this, precipitant.

But though precipitation is thus made with the solid body first united, a mixture may be formed anew, with the same solvend, by the addition of another solid body, and the same thing may be successfully repeated on every precipitation.

## LXV.

Another effect of mixture is, the difference of bulk in the aggregate, from their separate state. For the most part the bulk is less, though at times it is otherwise. Hence, a judgment cannot be formed of the proportions

of the ingredients, from the specific gravity of the particulars,

## LXVI.

These effects of mixture described, naturally suggest the necessity for some theory or explanation. This was first attempted on mechanical principles, and considered to depend on the size and shape of the particles of the bodies, and their being kept separate, or in a state of fluidity by agitation and motion. This theory, first suggested by Lord Verulam, was strongly reasoned on by Mr. Boyle, and later chemists. After this followed the theory of diffusion, or suspension of solids in fluids, from the minuteness of their particles. The specific attraction of the particles of bodies for each other, was then suggested by Sir Isaac Newton, a theory the most simple, and conformable to the other parts of nature. To this specific attraction, in order to a complete explanation, may in certain cases be also joined the extrication of an elastic aerial matter, and likewise the latent heat of bodies assuming a sensible form.

## LXVII.

This specific attraction differs from affinity, which is by no means an appropriate term, though preferred by some French chemists. It differs also from all the other species of attraction, and does not, like that of large masses of matter, dispose them to adhere in the least, but occasions a most exquisitely minute division of the particles of the substances mixt.

## LXVIII.

In order to the success of this species of attraction, it is necessary that at least one of the bodies be either fluid

or disposed to fluidity ; by means of which state the two are brought into closer contact, and this fluidity is produced in different bodies according to their nature, by means of solution, fusion, or evaporation.

## LXIX.

The first of these, or Solution, is favoured by,

1st, Mechanical division of the body, so as to extend its surface for the action of the fluid, or to encrease the sphere of its attraction :

2d, Agitation, so as to encrease the proportions of the body capable of solution, or to extend the limits of saturation :

3d, Heat, which encreases the powers of solution, until the vaporific point, when the body is changed to a different form ; and the several modes of its application with this view consist in,

a. Digestion, or a gentle heat promoting the action of the parts on each other :

b. Circulation, or the raising the more volatile parts, which are again condensed, and mix with the general mass.

c. Cohobation, or the pouring the liquor back after condensation, into the original mass.

## LXX.

When a third body is added in cases of mixture, and a preference is displayed in the attraction, by one of the bodies leaving the other to unite with this third, this preference is termed Elective Attraction.

## LXXI.

To explain this preference, the same principle of attraction is referred to ; but this preference is not sufficient

for a full explanation, and a repulsion between the third body added, and the body separated in the form of precipitation, must also be supposed to take place.

## LXXII.

It is by this power of elective attraction that many compounds come to be decomposed, which otherwise could not be effected. This subject was first systematically attended to by Geofery, who formed a table of such attractions. It has been enlarged and perfected by succeeding chemists. By this systematic knowledge of the special attraction of bodies, the chemist is enabled to foresee what will occur in his experiments, and to reason upon it in a certain degree.

## LXXIII.

Besides this elective attraction, or new combination of a single compound, another degree of it occurs in cases where two compounds are divided, and two new combinations formed, termed the Double Elective Attraction. The knowledge of this is equally necessary as the former, and its principles are at times very difficult to explain.

## LXXIV.

II. *Chemical Apparatus.*

We have thus considered the several powers, or agents in chemistry, and it is next proper to examine the manner in which these powers are employed, or act, in order to produce the different changes on bodies, which chemistry effects.

## LXXV.

This division consists in a detail of the chemical apparatus, and this apparatus may be reduced to three heads; the vessels in which the effects are to be performed; the

fuel, or means of producing heat; and the furnaces, or manner of applying it.

## LXXVI.

*Vessels.*

The variety in the first is, in their materials and form; and with respect to their materials, chemical vessels should be possessed of the following qualities:

1. Transparency to enable us to mark the changes going on:
2. Resistance to the action of corrosive or active substances.
3. Endurance of sudden alterations of heat and cold:
4. Strength to confine elastic vapours or steams:
5. Incapacity of being melted by great heat:

No material however is to be found possessed of all these qualities. Hence, vessels must be formed of the most suitable materials that can be had, adapted as much as possible to the special purpose or operation for which they are applied; and the best materials to be had for the different purposes of chemistry are, glass, metal, and earthenware.

## LXXVII.

Glass possesses the first quality, viz. Transparency. To give it the third, or the power to resist sudden changes of temperature, it must be made as thin as possible of a spherical figure, and well annealed, gradually cooled in the making it. With these requisites, and of the flint kind, which is preferable when much strength is not necessary, and when great changes of heat and cold do not suddenly take place, it is the best material.

## LXXVIII.

Metal possesses no other of the requisites enumerated, but the third and fourth. Its tendency to corrosion by acids, particularly when of iron or copper, may be somewhat counteracted by lining it. If the common lining is not sufficient, it may be done with silver or gold.

## LXXIX.

Earthen ware, the last material requisite for the purposes of chemistry, should have in its formation a proper toughness and firmness; but, except the resistance to heat, it does not possess any of the other qualities enumerated. To render it therefore more useful for different chemical purposes than in its natural state, several additions are made to it in its formation; as,

1st, Fine sand reduced to powder is mixt with it:

2d, Black lead is also mixt with it:

3d, The clay itself is prepared by burning it, and reducing it to a fine powder, and then mixt with the raw material:

4th, Porcelaine, or the finer species, is substituted, or else a mixture of glass and porcelaine, which is formed by putting a glass vessel into an earthen one, then surrounding it with sand and clay, and filling it with the same; when exposing it to the heat of a potter's furnace, it acquires the nature of porcelaine.

## LXXX.

From the materials we proceed next to the form of the vessels, which is entirely regulated by their use; and, in order to understand this, the variety of the operations must be considered; and as the separation of substances from one

another is effected by their solubility, fusibility, and volatility, the vessels fall to be examined as adapted to these purposes.

## LXXXI.

The vessels adapted to fusion are crucibles, which are of two kinds, the sand and clay, and the black lead. The former is best fitted for the fusion of acrid and saline substances, the latter for the metallic. Their form is made wide at top, and they gradually taper to the bottom. Their top is generally cornered, or formed into three angles, for the ease of pouring out their contents, and they are covered with a top to prevent extraneous substances or fuel falling in. When used, they are placed on a pedestal or piece of brick to prevent the cold affecting their bottom, or to preserve them of an equal temperature in every part. To give this vessel a greater power of resisting heat, a double crucible is employed at times, having its interstices filled up with sand. When the fusion requires little heat, instead of the crucible it may be done in an iron pot, or even a glass vessel.

## LXXXII.

The vessels adapted to convert bodies into vapour fall next to be examined ; and that operation is performed in three different ways :

By evaporation or ustulation, when we dissipate the volatile parts in order to retain the fixt parts :

By distillation or sublimation, when the volatile parts are retained and condensed ; and

By cementation, when the parts are only reduced into vapour, in order to act on each other.



## LXXXIII.

The vessels for the first of these operations, or evaporation, are open, of various materials, according to the nature of the substances to be wrought upon. All substances of a corrosive or saline matter, require the materials of glass; those of a metallic nature of metal, particularly iron; they should be of a globular form, and a part of them cut off at the top, so as to leave a good deal more than half the globe. When the humidity of the substance is wanted to be evaporated without injuring its other parts, porcelain or earthen ware is preferred, set upon the top of an iron vessel containing water, the steams of which only act upon the bottom part: when a violent heat again is wanted, a crucible answers for this operation. Various instruments have been also invented for this process of evaporation, which act by blowing showers of air through the liquor, so as to convert it, with as little expence as possible, into steam; the same plan is usefully employed in dispelling taint from liquors, particularly from water, by means of a machine resembling a gardener's watering pan, to which a pair of bellows are affixed, and made to send the air through the fluid.

## LXXXIV.

The vessels for distillation, or the production of spirits, come next in order. After this process the matter remaining is termed a Residuum; and when of a black hue or colour, a caput mortuum.

This process is conducted in three different ways; per ascensum, descensum, and per latus. To these varieties, therefore, the vessels are suited.

## LXXXV.

In the first the vapour ascending is forced down. This mode is used only in a very few cases, as the distillation of oil of cloves, and in procuring mercury and zinc from their ores.

The second species of distillation is most common, the vapour being allowed to ascend to some height, and then to take its way downwards into a cold cavity to be condensed; and the vessel most commonly used for this purpose is the common copper still. The improved form of it consists of the body containing the materials, and the head into which the vapour immediately arises; from the middle of the top of this issues a pipe which is directed to a side, and descends again in order to be inserted into the extremity of another pipe which descends into a large vessel of copper, containing a quantity of cold water. On descending into the vessel it then passes obliquely along the bottom of the opposite side, where it issues out, and where the vessel receiving the condensed matter is applied to it.

## LXXXVI.

Instead of the still, when the matter to be distilled is small, and of a corrosive nature, the cucurbit and alembic is preferred, or as the vapour is ready to act upon the material used as adjoining at the side, the retort and receiver answer, but which occasions the distillation to take place per latus: in doing this, there is only one point to be secured, which is not exposed directly to the steams when condensed. The receiver should be of the conical shape, as giving most room for the circulation of the steam and for extracting the substances collected in the vessel.

As noxious vapours are apt to arise in many operations, on the introduction of some of the substances, various ways of overcoming this inconvenience have been attempted by altering the construction of the receiver. Thus it is made luted, or with a hole at top; but this renders the heat unequal; and it is preferable therefore formed with a plug or stopper; it has been also made with a hole in the side, shut up with a stopper, so as to occasionally, by opening it, let out the steam and examine the odour; but in general it is sufficient to make the lute so tight as to confine only those steams that are capable of condensation, and a little hole may be made in it for allowing the more elastic ones to escape. But besides a hole, receivers have been also made with a pipe issuing from the side, termed spout receivers, for quickly carrying off the more volatile parts, though they are little used. To this apparatus belongs another part named the adapter, being also a receiver, with a pipe from its farther extremity intended to be fitted or adapted into another receiver, and so on until a string of them is formed for the more effectual condensation of the steams.

## LXXXVII.

To encrease the power of the retort in resisting heat, it receives at times a coating of clay or other materials, to about a quarter of an inch thick, which retains the vessel together, in case of cracks. For different operations retorts require to be made of the same materials as crucibles, and even occasionally of iron.

## LXXXVIII.

From the form of the retort the introduction of liquors into it becomes difficult without touching its sides; to avoid

this therefore, a funnel, termed the retort funnel, is required; and this is introduced so far as to put the matter into the body of the retort, and upon drawing it out it is kept applied to the upper part of the retort, while the drop hangs from the under part.

## LXXXIX.

The vessels for sublimation are less varied and numerous than those for distillation. The crucible and capital are occasionally employed; and in the great number of common cases a small apparatus is sufficient, consisting of an oblong glass vessel, the lower part of which is heated, while the other part is kept cool. In consequence of this, the steams arise and form a cake or sublimate upon the upper part of the vessel; and this is separated by cutting the vessel in two. In place of this apparatus sometimes the retort and receiver answer well. The retort must have a short neck, that the sublimate may not plug it up, and the elastic steams endanger its bursting. The long form of the receiver is also preferable to the globular for the ease of taking out the condensed matter. For this process, aludils were formerly much in use, being a set of receivers placed over one another, and below having an earthen vessel, the bottom of which can be made red hot. Thus the steams are raised to any height, and according to the condensibility of the fume, they occupied a higher or lower situation in the receivers, the top being terminated by an alembic.

## XC.

The vessels for cementation next occur, an operation so called from the manner in which the materials are disposed. It is generally performed in a crucible, and the

substance to be changed by this process is placed so, that an alternate layer of it, and of the material producing the change, takes place. Instead of a crucible, when large quantities of matter are subjected to this operation, as in the conversion of iron into steel, a chamber is fitted up in the furnace to answer this purpose.

## XCI.

The vessels employed in making mixtures and promoting solutions are next to be detailed; a common glass or porcelaine one is sufficient, if there is no great volatility, or any violent consequence to attend the application of the bodies to each other. Where such violence or ebullition occurs, instead of these common vessels, the phial achemica, or matrafs with a cylindrical neck, is preferred. When the quantity of the matter is small, a small vessel of the same form as the florentine flask will do. Where the heat is raised high in order to promote the action of bodies upon one another, the neck of the matrafs requires often to be larger, or to have another vessel applied to it to receive the steams and give room for condensation, which condensed matter will fall back; and this process is termed circulation.

## XCII.

Connected with solution falls to be examined Papin's digester. It is generally made of copper, very thick and strong, broad at top, with a lid fitted to it, which applies very exactly. There are two projections on the sides in order to make the lid go on in a particular manner; but they are unnecessary. There are then two projections to which may be fitted the two holes of a cross bar; and in the middle of it there is a strong serew, by which the lid can

be pressed down very strongly. By this machine water is made to bear a much stronger heat than in the ordinary pressure of the atmosphere. It is provided too with an apparatus for letting out the steam, if it should be in danger of bursting the vessel. A pipe is made through the lid, which is fitted with a valve, upon which presses a lever at a very small distance from the center of its motion ; and this can be made to press upon the valve with different weights, according to the distance at which these weights are placed from the center.

## XCIII.

To solution belongs also the apparatus for filtration of the matter remaining undissolved. To do this with a powdery substance, we allow it to settle, or the depuration per subsidendum to take place ; and it is best in a cylindrical vessel, or the liquor may be passed through a bibulous paper, which keeps back the smallest dust or impurity. It is folded in a particular manner, and placed in a funnel, in order that the liquid may pass through.

Under this head, may be also enumerated the different means of facilitating solution by mortars, sieves, files, hammers, &c. which encrease the surface.

## XCIV.

*Means of producing Heat.*

From the vessels we come to the second division of the chemical apparatus, or the different means of producing heat.

These may be arranged under seven different heads, viz. The principle of animal heat ; friction or percussion of hard bodies against each other ; electricity ; the mixture of certain bodies with each other ; fermentation and putrefaction ; the sun's rays ; and, lastly, fuel.

## XCV.

The first, or power which the animal system possesses of generating heat, is only employed in chemistry, in regulating thermometers ; and this degree of heat in healthy persons, is found pretty much uniform.

The second, or percussion of hard bodies against each other, is very transitory in its effect, and is applied chiefly to the kindling of gun-powder, but it is of little use in chemistry, and cannot be applied to large quantities of matter.

The third, or electricity, is perhaps superior to any heat that can be produced, and often very singular and circumscribed in its effects ; it is of no importance in chemistry, and therefore does not merit a particular consideration.

The fourth, or the mixture of certain bodies, produces only a transient heat, and is more to be noticed as producing cold, or a diminution of it. Thus several salts dissolved in water produce it, but particularly nitre and sal ammoniac, mixed with three times the weight of water. By this mixture the temperature may be reduced to  $20^{\circ}$  of Fahrenheit. But a still greater degree of cold may be produced by a mixture of ice and sal ammoniac, so as to bring down the mercury to the beginning of the scale, and by surrounding the vessel with wool, flannel, or fur, this cold may be continued for a long time. But a mixture of ice and snow with the nitrous acid acts still more powerfully than the former mixture ; and a cold may be thus produced to  $148^{\circ}$  of Fahrenheit below frost.

The fifth, or fermentation and putrefaction, are a power-

ful means of generating heat, which is also lasting and easily procured. It is used for promoting vegetation, and also in Egypt for hatching of eggs, as related by Rameaur. In chemistry it is employed to promote the conversion of various liquors into vinegar ; for the putrefaction of urine to make phosphorus ; and it is applicable wherever a long continued gentle heat is required. Horse dung and oak bark can maintain a heat to 120° of Fahrenheit; the former soonest arrives at heat, but it is also soonest exhausted, as in a month ; the latter is more gentle and lasting, continuing some months. Much depends on the quantity of the substance for the proportion of the heat, and the degree of humidity, which may be increased so far from the last circumstance, as to break out in fire.

The sixth, or sun's rays, is equal to the former in degree, and from being a dry heat, it is applicable to several other purposes, particularly the drying of vegetables, when the colour is of little consequence ; but this heat, by increasing the density of the rays, by means of a mirror or looking glass, may be increased to a degree as to dissolve and convert into smoke the densest metals. Many projects have been proposed to construct these vessels with still greater perfection, particularly by Mr. Buffon.

## XCVI.

The seventh and last means of producing heat is by fuel, which is the most frequently employed, and the variety in the effect of fuel depends on the various nature of the fuel itself, and upon the management and command of the inflammation. The variety and the nature of fuel may be reduced to four kinds.



1st, Inflammable fluids.

2dly, Peat or turf.

3dly, Wood or fossil coal in its charred state ; and,

4thly, Wood or fossil coal in its crude state.

### XCVII.

The first, or inflammable fluids capable of burning on a wick, are chiefly spirit of wine and oil ; they give the most equal heat, but cannot be employed to any great extent. The force of the heat depends on the size and number of wicks, upon which the fluid burns, and the equal manner with which they are fed ; spirit of wine is preferable to oil, as being more manageable, burning with a gentle heat, which may be raised the length of  $174^{\circ}$  of Farenheit ; it is also perfectly free of any extraneous matter or soot.

Oil, from being much disposed to emit soot, does not communicate the heat so quickly as spirit of wine ; and to obviate this, two methods have been fallen upon ; the employing a small flame or candle ; but as it scorches the wick, and has less power of sucking up the oil, so the flame is gradually diminished or the making a wick of asbestos, a substance composed of fibres resembling flax, but which can be thrown into the fire without sustaining any injury ; but still the oil evaporating from the wick, leaves a quantity of extraneous matter behind, and hinders the oil from being sucked up. No other remedy then remains, but frequently charging the wick, which however varies the strength of the flame.

### XCVIII.

The second, or peat, is a light spongy substance, inca-

pable of producing violent heat, and consuming fast. Its denser kinds when charred may be employed for a gentle heat, but in its rude state it contains so much volatile matter and water, as to occasion by exhalation much waste of its heat.

## XCIX.

The third, or wood and fossile coal, in a charred state is the most useful chemical fuel. The former, or charcoal, kindles quickly, emits, when burning, few watery or other vapours to clog the operation. When consumed, it leaves few ashes; these are light and easily blown away, without any disposition to melt. The only imperfection is, its being quickly consumed.

The latter or fossile coal differs from the former, in being more slowly consumed, and in producing more intense and lasting heat. Its inconvenience lies in the quantity of its ashes, a drossy matter.

The advantage of fuel in this charred state is its privation of watery and other volatile principles, which when present, prevent its rising to a heat above  $212^{\circ}$  of Fahrenheit, without being apt to break the vessel containing it. These principles however exist in various proportions in different coals; and in some, as the Kilkenny coal, are hardly in any sensible quantity, for it does not emit gross vapours that give any flame, and its heat continues long before it is consumed.

## C.

The use of charred substances is often attended with dangerous effects from the nature of the air they emit, nor is it less so in their crude state, though their effects are

more guarded against, as being conspicuous. On exposure to such air, the first symptom felt is a sense of weakness, which gradually encreases till the senses are lost, and the person falls down apoplectic. This state is attended with a deep snoring sleep, a full pulse, insensibility to the objects around, with flushing of the face, and foam at the mouth. The treatment consists, after immediate removal to a free atmosphere, in first employing venesection, then throwing cold water on the head, and applying a powerful stimulus to the lower extremities. In some cases even the actual cautery has been successfully employed.

## CI.

The fourth, or wood and coal in the crude state, give out a sepious and vivid flame, when air is admitted to them, which renders them applicable to particular purposes. This flame is nothing more but the inflammable matter contained in these substances set on fire. This inflammable matter in wood and coal, in their crude state, rises in the form of oil and sooty steams, which, when plenty of air is admitted, breaks out into a flame, and continues as long as the oil and steams ascend. During this inflammation the principle of inflammability is consumed, and produces the intense heat, so that the volatile matters are soon dispersed through the air, and lost. The advantage of this fuel consists chiefly in the most violent heat being produced by it, and that in any form; but it is improper for a gentle and long continued heat, and when the fuel is added in small quantity to obviate this, the heat produced cannot be regular. Any degree of heat therefore, may be raised with this kind of fuel, pro-

vided a strong current of air is made to rush through the inflammable matter.

## CII.

Such are the principle varieties of fuel, by which they are fitted for the different purposes of chemistry; besides heating bodies more or less, they possess some other qualities, in consequence of which they produce different changes upon bodies. These changes depend upon something added to the fuel, or upon something taken from it, to be afterwards considered.

## CIII.

*Modes of applying Heat.*

From the means of producing heat we proceed to the third division of the chemical apparatus, or the contrivances for applying it, and by which its force is regulated. These comprehend furnaces, and some other parts connected with them.

The principle required in the construction of every furnace is,

1st, The confinement of the heat; and,

2dly, The proper inflammation of the body to heat it.

The first of these, or the confinement of the heat, is by means of a chamber or cavity; the sides of which are of some thickness. This cavity is furnished with a door, at which fresh fuel may be put in; and it is provided also with a grate, for the reception of the ashes when formed, and under this grate there is a cavity to admit the air to the fuel, and at top there is also an opening to allow the smoke or burnt air to ascend.

## CIV.

The next circumstance in the construction of furnaces

is the method of regulating the heat ; and this is done by regulating the quantity of air passing through the fluid. In order to do this, it is proper to have the command of the apertures below ; and this command is obtained either by the door of the ash-pit, which may be shut or opened at pleasure, or the door of the ash-pit being completely closed, a set of round holes may be formed to the number of seven or eight, which bear a certain proportion to one another.

Where a very great degree of inflammation is required, the command of the aperture above as well as below is necessary, as encreasing the height of the vent, which will add to the force of the current below.

#### CV.

From these general principles in the construction of furnaces, we now consider the different kinds of them as applied to special purposes ; and the first to be noticed is the melting furnace. This furnace has all the parts already described. The fire place is covered with a dome from which there rises a tube to some height, and to which another additional tube may be added to the height, in all of about ten feet. The shape of the fire place is narrow below, widens in the middle, and generally contracts a little again for the sake of the form of the vessel which is put into it, and which is wider above, and by that means is equally heated : there is room above for containing a quantity of fuel, that may descend as fast as it is consumed.

A small portable furnace of this kind is very convenient for ordinary crucibles, the largest of which is only about four or six inches high, the wider part of the fur-

size may be beat out ten inches diameter, and when made of thin plate iron, and lined within, such furnaces are quickly heated with no great expence of fuel; but for heating large vessels, it is more proper to construct them of brick, when they have pretty much the same form, only it is necessary to make them square, the inside being made round by putting in a composition of lute made of sand and clay; the top is generally made flat, and covered over with two or three bricks; the vent goes a little backwards, then is raised up a proper height. When the vessel to be heated is very large, it is common to leave the front open for putting in the vessel, and to fill it up with bricks, clay, and sand, which is afterwards pulled down again, when the operation is

## CVI

When a rapidity of inflammation is wanted, beyond what this structure can produce, recourse is then had to various means of employing the air; as by the use of bellows of different constructions, by which the air can be compressed, and made to issue with considerable velocity; and to give them greater power, they are sometimes wrought by the force of water: but, besides this, another way in which a still greater effect can be produced, is by the water blast.

## CVII.

Next to the melting is the essay furnace, in the use of which, to save expence, the fuel is in the inflammable state; and to understand the effect of fuel in this state, it is proper to examine the operation of the blow-pipe; it is generally made of glass, or brass with a large

cavity towards the one end, from which issues a small pipe perforated with a small hole not sufficient for a pin; by this a small stream of air is sent through the candle, while the cavity condenses the steam of the breath, that it may not disturb the operation. The small stream of air being more intimately mixed with the flame, and agitated with it, occasions a more complete consumption of the vapour, and makes it produce much more heat. As an improvement on this instrument, when the violent effects of heat are wanted to be investigated, a pair of bellows are used, placed under a table with a pipe, which rises through it, and to which the blow-pipe is fixed.

## CVIII.

The reverberatory furnace comes next in order, and is appropriated solely to the melting of iron; it has all the usual parts of a furnace; the ash pit has a communication with the external air, and is sunk under the level of the ground; when wanted to resist violent heat, it is lined with certain materials, as a mixture of clay and sand, which has the effect of resisting bodies of a corrosive nature.

## CIX.

The potter's kiln consists of a pretty large cavity, entirely filled up with columns of earthen ware, contained in a sort of cases of the same material, to defend them from being affected by the smoke, and grosser part of the flame.

## CX.

The glass-house furnace is one well known, and its specifications depend upon the circumstances, that it is necessary to keep up, uninterrupted, a very violent degree of heat;

and it is necessary also, that access be given to the materials.

## CXI.

The next furnaces are those employed for evaporating and digesting, and for promoting the action of bodies on each other. The first of them is the common still, and it differs chiefly from the melting furnace in the situation of its vent.

The others of this kind are for heating vessels, and as the heat requires to be applied gradually, they are provided with a pot of iron into which the vessel is put, and is covered all round with sand, whereby the heat is transmitted more equally and gradually, than if the vessel was suspended over the naked fire. This is what is called the balnea or baths in chemistry.

## CXII.

Digestion consists in the application of a moderate degree of heat, so as to promote the action of the several ingredients on each other; and this process is performed either by the sand bath, or where a long continued heat is required, by a particular furnace called Athanor. This last, however, has never come into general use, and does not at the same time answer with our fuel.

## CXIII.

*Dr. Black's Furnace.*

Such are the principal forms of the chemical apparatus, but in certain arts, some furnaces of a particular construction are preferred, as in enameling, melting, and separating metals from their ores. Chemists also have attempted to adapt a furnace to all the different kinds of



operations, it being troublesome to be provided with a number. The best on this plan is that of the late Dr. Black. It is formed by joining together two thick iron plates above, and below by a thinner plate from the body of the furnace, which is of an oval form; the upper plate is perforated with two holes, the one pretty large, which is often the mouth of the furnace, and which is circular; another behind it, which is of an oval form, intended for fastening the vent to, which is screwed down upon this hole. The undermost thick plate has only one perforation near to the middle, but not altogether so, being nearer to one side of the ellipse than to the other, in which the round hole in the top is formed, so that a hole passing the center of this circular hole, has a little obliquity forwards. The ash-pit is made of an elliptical form like the furnace, and a very small matter widened, so that the bottom of the furnace goes within the ellipse, and a little below there is a border that receives the bottom of the furnace, and, except the hole of the damping plate, the parts are all closed by means of a quantity of soft lute put on, and upon which the body of the furnace is pressed down. By this means the joining of the several pieces is made quite light; for the body, fire-place, ash-pit, vent, and grate are all separate from one another, as the furnace comes from the hands of the workmen. The grate is made to apply to the outside of the lower part. It consists of a ring set upon its edge, and thin bars are likewise set upon their edges. From the outer ring proceed four pieces of iron, by means of which it can be screwed down, so it is kept out of the cavity of the furnace, and preserved from the extremity of heat, whereby it lasts much longer, and is hard-

ly indeed liable to any decay; for by being exposed to the cold air it is kept so cool, that the iron is never destroyed. The sides made of plate iron are luted within to confine the heat, and defend the iron from the action of it.

## CXIV.

For adapting the furnace thus described to the different operations of chemistry, it may be observed that, to form it into a melting furnace, a cover must be provided for the opening above, which is made the door, and being immediately over the grate, this is very convenient for the introduction of substances that are to be acted upon, for allowing to inspect the vessel, and to take the substance out. This cover may be composed of a piece of tile, or two flat square bricks, or a lid of plate iron may be joined, made with a rim that contains a quantity of luting. To produce also more heat, the height of the vent may be encreased. This furnace can be employed in most operations in the way of assaying. It does not admit the introduction of a muffle, but still it can be employed in those operations, where a muffle is used. It may be also used in calcination of lead, to convert it into litharge. Nor is it less useful in the operations for producing vapour. Where employed for such distillations, as require an intense heat, the earthen retort is to be suspended by means of an iron ring having three branches standing up from it, and which hangs down from the hole one half foot, so that the bottom of the retort rests upon the ring, and is immediately over the fuel. The opening between the mouth of the furnace and retort is filled up with broken

crucibles, or pot stills, and these are covered over with ashes transmitting the heat very slowly. It answers also for distillation with the naked fire, and to do this the furnace must be provided with a hole in the sides, from which the neck of the retort can be made to come out, which can be easily again repaired. In this way distillations with the strongest heat may be performed. For distillations again performed with retorts in the sand bath, an iron must be fitted for the opening of the furnace, which is set on and employed as a sand pot, while the vent of the furnace becomes the door. For this purpose it answers well, and is more easily kept tight than when it is in the sides, and may be covered with a lid of charcoal and clay.

### CXV.

#### *Lutes.*

The last part of the chemical apparatus to be considered is what are termed lutes, which are additional substances applied in order to close the joinings of vessels, to render them more capable of enduring heat without rupture, to change their form, or to give a coating or lining to furnaces.

### CXVI.

Lutes are composed either of animal or vegetable matter, as clay, chalk, gum arabic, flour and water, wet ox bladder, linseed meal, putty, &c.

### CXVII.

To the use of lutes attention is necessary to prevent the bursting of the vessels; and for this purpose a small hole or opening should be made with a pin or wire to allow part of the gas to escape.

## CXVIII.

Of the different lutes the best is a mixture of clay and sand, in a proportion proper for standing the violence of fire. This proportion for luting is four parts of sand to one of clay; but where the inside of a furnace is to be lined, the proportion should be six or seven parts of sand to one of clay, in order to prevent the contraction of the latter. But even this is insufficient; and to render the lining more complete, clay should be used with a large proportion of charcoal dust. This is put first next to the iron, to the thickness of about an inch and an half. It must be put in very dry, in the proportion of three parts of charcoal by weight, to one of clay mixed in powder. As much water is then added as makes the powder form into balls like those of snow. These balls are to be beat with a hammer very firm upon the insides of the furnace. The other lute is then spread over it, to about the thickness of half an inch, and is beat solid upon it by a hammer, being allowed to dry slowly, that all cracks and crevices may be prevented. After the body of the furnace is thus lined, the vent is screwed on, and lined in the same manner. When once dried, which requires a long time, a fire is kindled in the furnace, which is gradually heated for a hour or two, and then raised to the greatest intensity. By this proceeding the lute becomes equally hard and solid as the furnace.

## CXIX.

\* Such is the general view of the chemical apparatus, the proper use of which can be only learned by experience;

and a farther detail of this part will be found in most practical authors on the subject.

### CXX.

#### III. *Particular Doctrines of Chemistry.*

Having finished the general or introductory doctrine of chemistry, by an examination of its powers, and their general mode of application, we next enter upon their particular detail, in order to a detection of the various nature and qualities of bodies.

### CXXI.

To do this successfully it is necessary to establish first those general elementary principles of which all bodies are composed, at least so far as chemistry has been able to detect them, and by examining these principles, and afterwards pursuing their various combinations, the full extent of the science is attained.

### CXXII.

#### *Oxygen.*

The first and most general principle in bodies, detected by chemistry, is what is termed oxygen, or the acidifying principle, a power of universal agency, and essential to three great processes, the respiration of animals, combustion, and the formation of acids; this principle is never found in an uncombined state, and it is only from its combinations with other bodies that it is obtained. Its tendency to combination is perhaps stronger than that of any other substance. It combines with every inflammable or combustible body. It does the same with all the metals. It forms a proportion of the atmospheric

air: and it composes a chief part of all vegetable and animal matter.

CXXIII.

This principle was first discovered by Dr. Priestley and Mr. Scheele, in its aeriform state, and has received from them a variety of appellations. It is procured by the application of heat from a number of substances, as,

CXXIV.

1. From the black oxyd of manganese, when exposed in an iron vessel to a red heat.

2. From the mixture of this muriat, with the sulphuric acid in the proportion of  $2\frac{1}{2}$  parts of the latter, and submitting the mixture in a retort to a gentle application of heat.

3. From heating nitre, red lead, or red oxyd of mercury.

4. From the exposure of growing vegetables to the action of light.

CXXV.

The effect of this principle in its combination with acids differs according to the proportion of it present in them. Thus,

1. When their bases are not saturated with it, such acids are designated by the particular termination of *ous*.

2. When a complete saturation takes place, they receive the termination of *ic*; and,

3. When they possess an excess of this principle, they are named oxygenated.

## CXXVI.

The consequence of its combination with metals is also varied; thus,

\* When no obvious acidity is produced by appearance of combustion, the metals receive the name of oxyds, and its combination with them, *oxidation*. When an obvious calcination, or combustion takes place, they are termed oxygenated, and the process *Oxygenation*.

## CXXVII.

This principle and that of light we find always in opposition to each other. Thus the combination of oxygen with any body produces evaporation of light, and the extrication of oxygen rarely takes place without the agency of light.

## CXXVIII.

*Nitrogen*

The 2d principle, equally universal in bodies with the former, is what has been termed Nitrogen. Like it this substance is never found in an uncombined state. It is an essential ingredient in all animal substances, and has received the appellation of azote and septon by different authors.

## CXXIX.

This principle, like the former, is also of modern discovery. It is particularly obtained by exposing atmospheric air, in which it abounds, to substances capable of absorbing or withdrawing the oxygen it contains. Thus,

a. By exposing a quantity of air in a jar to the fumes of pot-ash, the absorption of the oxygen will soon leave nitrogen behind.

## CXXX.

2. The combustion of phosphorus, or the metals in atmospheric air, by their absorption of oxygen, to form a solid compound, will leave the azote or nitrogen in a gaseous state.

## CXXXI.

This principle forms the base of the nitrous acid, and according to the proportion of it, combined with this base, and the former principle or oxygen, it is distinguished by different appellations, or into the nitric and nitrous acids.

## CXXXII.

The existence then of this principle in atmospheric air is in the proportion of  $\frac{1}{4}$  of the compound. It forms the distinguishing characters of animal matter; and it is likewise present in the vegetable kingdom.

## CXXXIII.

*Hydrogen.*

The next of the elementary bodies is hydrogen, or that principle considered as the basis of water. It differs from the two others as it may be said to exist in nature, for it is often collected in the roofs of caverns and mines.

## CXXXIV.

The discovery of this principle was owing to Mr. Cavendish, and it is easily procured by the decomposition of water. Thus,

1. If water be put over iron, or iron filings, heated to ignition, a decomposition takes place by the separation of its oxygen, and abundance of hydrogen is produced.



2. The same effect is produced if a mixture of  $2\frac{1}{2}$  parts of water, and one of sulphuric acid be poured on either of these metals an effervescence ensues, and a copious extrication of hydrogen.

## CXXXV.

Hydrogen combines with other bodies. It is a principal ingredient in animal and vegetable matter, and is particularly produced by their resolution. It is also capable of dissolving carbon, sulphur, and several of the metals.

## CXXXVI.

With this foundation of their elementary principles, we begin the detail of the different classes, into which the subjects of chemistry are arranged; and the first of them that falls to be considered is that of *airs*.

## CXXXVII.

Class I. *Airs*.

The discovery and extent of this class of bodies form the great merit of modern chemistry. It owes perhaps its discovery to Boyle and Hales, its extension to Priestley and some others, but the proper application of it is entirely due to the celebrated Lavoisier. It comprehends all those substances which are so rare as to be invisible, and this rareness or aeriform state is to be considered as depending on the agency of caloric, or the matter of heat.

Where this state is the effect of a high temperature, such airs are termed vapors, and they return on its removal to a solid or fluid form. Where it takes place in a low temperature, such bodies remain permanently elastic, and receive in common language this name.

## CXXXVIII.

In their properties the several species of airs differ equally from each other, as the substances in the other classes of bodies; and this difference renders a division of them to be made in a medical view into those which are capable of supporting animal life, and combustion, and into those, on the contrary, that destroy it.

## CXXXIX.

I. *Vital Air, (Oxygen Gas).*

Of the former the principal is vital air, termed also dephlogisticated and empyreal air; a substance destitute both of taste and smell, but possessing in an eminent degree the power of increasing and supporting animal life and combustion. It is heavier at the same time than atmospheric air, in the proportion of 1103 to 1000, and the latter maintains life only in consequence of the quantity of this fluid it contains. This proportion is rated at 27 to 100.

This air changes also the colour of animal and vegetable substances. It is a composition of oxygen and caloric. Combustion by it, is rendered amazingly intense; and its powers, when urged by the blow pipe, far exceed the powers of any burning lens.

## CXL.

From this body being of such importance in combustion, a consideration of that process becomes proper here.

*Combustion.*

The chief phenomena of combustion are heat, motion,

flame, redness, and the change of the nature of the substance that is burnt.

The manner in which this takes place differs in its degree and appearance in different bodies, but the effect in all is the same, the body being no longer capable of this process, and its residue acquiring an additional weight. This is clearly proved in bodies of a fixed nature, and the same also in those that are volatile, where their product has been confined.

### CXLI.

The causes of these phenomena of combustion, and its effects have given rise to a variety of opinions at different periods of chemical history. M. Lavoisier's opinion has been adopted by modern chemists, which considers this process as the combination of oxygen with the inflammable body, the attraction of the latter for which only takes place at a certain temperature. Combustion then is simply a process of combination. The residue of this process is a new substance or compound, and in the formation of this compound the caloric, or matter of heat, is evolved from the oxygen as it enters into this combination.

### CXLII.

The proofs of this theory, rest on four principal facts :

1. The necessity for the presence of oxygen or vital air, in order to combustion taking place, and the rapidity of the process depending on its quantity.

2. The actual consumption of vital air in every case

3. The increased weight of the substance after combu-

tion, and this weight corresponding to the quantity of vital air consumed; and,

4. The actual recovery of this quantity of vital air, from the product or burnt substance.

### CXLIII.

The establishment of these facts confirms the justice of the theory, and it remains to explain that evolution of light and heat which is so conspicuous during this process. It is clear of the two bodies, the oxygen and combustible substance, the former possesses the greater share of these principles, especially caloric; from the oxygen therefore this evolution of heat, or caloric, must proceed in order to accommodate its capacity or volume to that of the combustible substance, with which it is to combine; and the proof of this is drawn from two facts:

1. That the capacity of the oxygen is always greater than that of the combustible body, with which it unites:

And, 2. That the capacity of the compound is always less than that of the oxygen, though greater than that of the combustible substance, but still inferior to the capacity of the two.

### CXLIV.

The extrication of light, again is considered as rather arising from the combustible body, and disengaged from it by the oxygen. Though this point is not completely established, many circumstances render it highly probable.

### II. Foul Air (*Nitrogen Gas*).

This air, named also mephitic and azotic gas, is a substance unlike the former, being of a smell peculiar and

unpleasant. It is incapable also of supporting animal life. It extinguishes flame, and is only characterised by its possessing none of the distinguishing qualities of the other known airs. It is lighter than common air, in the proportion of 985 to 1000. It may be considered indeed as the residue of common air, when vitiated by combustion. It is easily disengaged from animal matters, by a slight increase of temperature; but different parts of animals afford different proportions of it, and the concrescible sitrous matter the most. The proportion of it they in general afford is proportioned to their quantity of volatile alkali.

By this air delicate blue colours are slightly reddened.

#### CXLV.

#### III. *Inflammable Air (Hydrogen Gas).*

This air, named also fire damp, is peculiarly distinguished by its great levity and inflammability. It is the lightest substance whose weight we are able to estimate. When pure, it is 13 times lighter than atmospheric air, and it immediately explodes on mixture with oxygen. It is formed by the union of hydrogen and caloric. Its lightness is particularly evidenced by its use in balloons. Plants grow in this fluid without impairing its inflammability. Water imbibes about  $\frac{1}{10}$  part of it; and when again expelled, it is as inflammable as ever. By this addition both its bulk and specific gravity are increased; for it occupies  $\frac{1}{13}$  more space by its combination, and its weight is increased to be only  $\frac{1}{13}$  lighter than common air.

#### CXLVI.

. Those then are the three simple or original gases, from

which variously modified, all the rest are produced; and the first of these productions universally diffused, and of the first importance to life, being what we constantly breathe, and by which we are surrounded, is atmospheric air.

## CXLVII.

IV *Combined Air, or Atmospheric Gas.*

Atmospheric air is a mixture of various substances in the elastic state, for it is exposed to the combination of all those bodies which are capable of being disengaged at the surface of the earth, at its common temperature. By the powers of chemistry this fluid, when examined, is found to consist of three principal parts, vital air, azote, and carbonic acid in certain proportions. From the abundant production of inflammable air, or hydrogen gas, at the surface of the earth, in consequence of the corruption or decomposition of animal and vegetable matters, this fluid must also be generated, yet its extreme levity will naturally carry it to the higher regions, so that, though a part of the atmosphere, it is placed in a situation beyond the examination of chemistry.

## CXLVIII.

To a mixture then of vital and foul air with carbonic acid, the term atmospheric air is applied; and this mixture is in the proportion of 27 parts of vital air, 72 of foul air, or azote, and 11 of carbonic acid.

## CXLIX.

The proofs of this composition of atmospheric air were first offered by Mr. Scheele, who found, on its exposure to certain substances, that it suffered a diminution of vol-

lume, and that by this diminution it was rendered unfit for the support of life. This abstracted part therefore could not fail to be oxygen or vital air; and from this combination of oxygen, and foul air or azote, he naturally inferred that atmospheric air came to be formed. This he farther confirmed by restoring oxygen to it, in consequence of which it regained all its properties of atmospheric air. On the same subject he was succeeded by Lavoisier, who, in addition to these facts, shewed that the oxygen, or attracted part, was received by the substance producing the change, and could be often recovered again from it.

### CL.

But, though the composition of atmospheric air has been thus ascertained, something still remains wanting to complete it; and this in the manner of combining by experiment its parts. Hence it is doubted whether its parts exist naturally in a state of chemical combination, or of mechanical mixture. That the latter takes place appears probable from the different proportion of oxygen which it is found to contain in the higher and lower regions; it being always greater towards the surface of the earth; and from the unlimited proportion in which these airs can be mixed, while the different matters present in the atmospheric regions may tend strongly to prevent their separation. At the same time, as a proof of its simple mixture, it is soluble in 35 times its weight of water.

## CLI.

*Eudiometry.*

From this knowledge of the composition of atmospheric air, an attempt has been made to ascertain its purity, or its relative capability of supporting animal life in different situations. This is effected by eudiometry, or measuring the exact quantity of oxygen the air contains.

## CLII.

To do this it requires to add to the air some body capable of combining with its oxygen, and from the diminished volume of air, the quantity of oxygen is inferred.

## CLIII.

Different substances have been employed for this purpose, and each preferred by different chemists.

The aqueous solution of sulphuret of potash, forms the eudiometer of Scheele, but, though complete in its operation, it is slow, and does not possess a criterion to shew when it is finished. The same objection applies to the dry sulphuret of potash, and is at the same time difficult to employ. The eudiometer of Volta is composed of hydrogen mixed with a determined quantity of air; but the hydrogen not being uniform in quality, renders it liable to error, and it is uncertain to which of the bodies the diminution is owing.

## CLIV.

Nitrous gas added to any air, containing oxygen mixed.



with it, will abstract the oxygen; but the result is uncertain, from the varying quality of the nitrous gas.

## CLV.

The slow combustion of phosphorus over water is the most precise application of this kind, and the completion of its process is indicated by the loss of its luminous appearance in the dark, or of its surrounding cloud in daylight.

## CLVI.

But eudiometry applies only to the quantity of oxygen present in the atmosphere. This fluid is rendered however unwholesome, by various other impregnations arising from effluvia, the effect of situation or season, in which the quantity of oxygen is not at all concerned. Hence it forms but an imperfect criterion of the relative healthiness of different places.

## CLVII.

Atmospherical air is without taste, and for the most part without smell. It is invisible, transparent, necessary to the support of combustion, vegetation, and animal life, particularly respiration. It is absorbed in a certain quantity by water, and again expelled by boiling, or by the air-pump removing pressure.

## CLVIII.

But this solvent power of air is considerable, when assisted by caloric. Hence the spontaneous evaporation that is constantly going on in bodies; and that the air has an effect as a solvent in this case, appears  
 1. From its always containing a proportion of water.

2. From more water being evaporated in a dense than in rare atmosphere, and,

3. From ice diminishing in weight even in a temperature under 32.

## CLIX.

The solvent power, however, of air is much increased by a high temperature; and in this high temperature it takes place, even in a degree greater than the bare ratio of augmented temperature can account for.

## CLX.

As the gravity or pressure of the atmosphere is constantly varying, to mark this variation an instrument called a barometer has been invented. This instrument consists of a tube containing a column of mercury 28 inches in height, being ascertained as the exact counterpoise of a column of air, of the height of the atmosphere. This tube being open below, and having a vacuum above, the mercury rises and falls in it according to the varying surface of the surrounding or circumambient fluid.

## CLXI.

With the same view, to determine the varying quantity of water the atmosphere contains, another instrument, the hygrometer, has been employed. This instrument is formed of substances which shrink easily by dryness, and in the same degree swell by the application of moisture.

## CLXII.

IV. *Alkaline Air (Aromatic Gas).*

This air possesses a strong pungent smell, and is even ca-

pable of inflaming the skin of animals. Its lightness is next to that of inflammable air, and in specific gravity it falls short of atmospheric air, in the proportion of 600 to 1000, and it is incapable of supporting animal life, and also combustion, though the flame of a candle enlarges before it is extinguished. By it is proved to be a compound of this azote and hydrogen, 1000 parts of it containing 807 of azote, and 193 of hydrogen. This air has a strong attraction for water, and is rapidly absorbed, it. When dissolved with water it produces heat; and when dissolved with ice it produces cold.

## CLXIII.

V. *Nitrous Air (Nitrous Gas).*

This air is colourless, and incapable of supporting either animal life or combustion. It is composed of oxygen and azote, in the proportion of 56 to 44. Its specific gravity to that of atmospheric air, is as 119 to 100. Though incapable of supporting combustion in general, some substances burn in it with splendour. It does not redden any of the vegetable colours, or shew any acid properties. Its most striking and important property is the facility with which it combines with vital air. This shews itself on the immediate admission of atmospheric air, by the appearance of red fumes, and the diminished volume of the air. When oxygen is admitted pure, the diminution of volume is still more rapid;  $2\frac{1}{2}$  parts of this gas are saturated by one of oxygen, and by this combination no light and little heat is extricated. From this circumstance of its combination with oxygen in a common temperature, and its forming a compound easily absorbed by water, it has been applied to the uses of eudiometer.

try. Thus a given quantity of the gas is added to the air containing oxygen. The diminution of volume produced, is measured by a graduated tube, and the quantity of oxygen estimated from the quantity of oxygen required to make a full diminution. But though this method forms the eudiometer of Priestley, Ingenhouz, and Fontana, it is by no means accurate in its results, being influenced by a variety of minute circumstances. When mixed with hydrogen, this air burns with a green flame.

## CLXIV.

VI. *Depleted Nitrous Air (Gaseous Oxyd of Azote).*

This air resembles vital air in both supporting combustion and animal life. Phosphorus burns in it with splendour and sulphur with a vivid rose coloured flame. But this combustion only takes place, when bodies are raised to a higher temperature than what is necessary in vital or atmospheric air. In maintaining life it acts as a powerful stimulant without producing any exhausting effects. By means of the electric spark it is converted into nitric acid and atmospheric air, and its constituent parts are 37 of oxygen, with 63 of azote.

## CLXV.

VII. *Fixed Air (Carbonic Acid air).*

Fixed air, or aerial acid, is incapable of supporting combustion and animal life. It possesses a penetrating odour, and sour taste. It reddens the vegetable colours, and its composition seems to be 28 parts of carbon, or the peculiar inflammable matter of charcoal, and 72 of oxygen with a certain portion of caloric. The proof of this ap-

appears that pure charcoal being burnt in a vessel of vital air, carbonic acid is directly formed in a quantity precisely equal to that of the two ingredients employed.

## CLXVI.

This air was first discovered by Dr. Black. It is abundantly in nature, and is produced in a variety of circumstances. It is heavier than the air of the atmosphere in the proportion of  $1\frac{1}{2}$  to 1 part. It is found in a pure state in many subterraneous places, and is known by the common name of chok'd mine. It is generated during the decomposition of animal and vegetable substances by fermentation. It composes a fourth part of the atmosphere of calcareous strata. It is absorbed by the solution of alkalis, and likewise by the lungs. It is dissolved in equal bulk of water at a moderate temperature, and under the common pressure of the atmosphere, and it acquires in consequence a peculiar taste. It forms therefore a constituent part of many mineral waters, which acquire from it a pungency and sparkling quality.

## CLXVII.

VIII. *Hydrogen* ( $\text{C}_2\text{H}_2$ ).

This air is distinguished by a peculiar odour, capable of giving a smell or sulphureous colour. It is necessary to animal life, and redens the vegetable colours. It exerts a green flame, but in contact with vital air, it burns with a bright blue flame, and at the same time it deposits a residue of sulphur. It prevails abundantly in the sulphureous mineral waters which are situated with it. It consists of a compound of sulphur and inflammable air in the proportion of 1 part

of the sulphur, every species of Hepatic indicate a slight acidity.

## CLXVIII.

*Hydrocarbonate (Carbonated Hydrogen Gas.)*

May be considered as a modification of fixed air. It is inflammable; it is heavier than atmospheric air as 11 to 23. It is more immediately fatal to animal life than the greater number of gases, and it has the peculiar property of communicating to the blood and muscles a florid red hue. The composition of this air is 4 parts of carbon, 3 of hydrogen, and 9 of water.

## CLXIX.

Two other modifications of the same gas are also produced.

The one contains a larger proportion of carbon, the other a larger proportion of oxygen.

## CLXX.

9. *Vitriolic Air, (Sulphuric Acid Gas.)*

This air has a strong suffocating odour and acid taste, and proves speedily fatal to animal life. It is not inflammable, and extinguishes combustion. It is absorbed by water, the solution retaining the pungent smell of the air. It renders the vegetable colours white. By water it is imbibed in the quantity of 90 times its bulk, and it is not expelled by freezing, like other kinds of air.

This air is a compound of sulphur and oxygen, the latter being in a less proportion than in the sulphuric acid, with a certain quantity of caloric.

## CLXXI.

10. *Marine Acid Air, (Muriatic Acid Gas.)*

This air has a penetrating smell: it is sharp without being caustic: it extinguishes flame, and proves fatal to life. Mixed with atmospheric air, it even excites a sense of suffocation. It is heavier than common air, and as it extinguishes flame, it enlarges it by a greenish or blueish circumambient circle. Its specific gravity to that of atmospheric air is as 5 to 3.

## CLXXII.

11. *Phosphoric Air, (Phosphoric Acid Gas.)*

Phosphoric air has a fetid putrid smell, it enflames on coming into contact with atmospheric air. It detonates when mixed suddenly with oxygen. It is speedily destructive of animal life. It slightly reddens tincture of Litmus. It consists of a solution of phosphorus in inflammable air.

## CLXXIII.

12. *Air of Sparry Fluor, (Fluoric Acid Gas)*

This air has a pungent penetrating odour. It is incapable of supporting combustion. It is heavier than atmospheric air. Its constituent principles are not ascertained.

## CLXXIV.

Having thus examined, in a general way, the natural and factitious airs, and detected their leading properties, we are next to consider their application to the purposes of medicine. Till the discoveries of modern chemistry, the use of air in medicine was confined solely to the atmospheric, and its relative degrees of salubrity engaged alone the attention of physicians. The first of the factitious

airs that came to be introduced was the Fixed air, or carbonic acid gas, in consumption and several other complaints. Since that time the labours of Dr. Beddoes have opened a new field of speculation, and the general application of this form of bodies in the cure of diseases has been attempted, if not always with success, at least with a considerable palliation of many urgent symptoms.

Of the different airs, we find three alone capable of maintaining life, viz. vital air, atmospheric air, and dephlogisticated nitrous air.

## CLXXV.

Vital air, when inspired pure, or nearly so, increases the activity of every part of the system, and to that degree as often to occasion violent and mortal inflammations. By giving an increased redness of color to the blood, it brightens that of the solid parts: even the liver, the organ the least disposed to assume this appearance, seems to partake in the general change induced by it. That it increases the powers of life, is evident by its rendering animals less capable of being drowned or destroyed by cold: that it is exhausted by muscular exertion, is evinced by animals that have been much in motion, sooner exhausting a certain quantity of it. When blown into the cellular membrane of animals it is found to excite an uncommon vivacity. To these effects may be added its strong power of irritation on the surface when any part of it is denuded. Thus a sore immersed in vital air, has its inflammation and smarting soreness powerfully increased. At the same time this very effect may prove useful in ulcerations, and the application of oxygen or bodies containing it may be a powerful means of cure.



## CLXXVI.

In consumption the use of vital air has been found highly pernicious, and this in a great number of cases tried by different practitioners. The cough is increased by it, the fever becomes more violent, and all the symptoms are aggravated. The same is to be observed in asthma, where the stricture and uneasiness of the chest are rendered more severe, in consequence of its application. But in diseases where the patient has been affected with languor and debility, this air has been found highly serviceable. It has been employed in cholera with sudden relief. In coldness of the extremities of the old and infirm, it has been remarkably efficacious. It excites a flow of animal spirits, without that exhaustion consequent on the use of other stimulants. In malignant fever also its exhibition has been attended with the most marked success.

## CLXXVII.

From this circumstance of the hurtful effects in phthisis of oxygen in a pure state it naturally occurred, that its combination with azote in a varied proportion from what it is in the atmosphere might correct this hurtful tendency, and render it on the contrary, from the facility of its application to the seat of the disease, a principal means of cure. — Various tables of this kind have been formed by Dr. Beddoes both of a higher and lower standard of atmospheric air, the latter of which has been accordingly found particularly useful in consumption, both in retarding the progress of the symptoms and in altering the setor that attends the discharge. Thus he has varied the proportion of oxygen from 28 parts in the 100 in common standard to 22, in his higher scale, and diminished the azote to only 12,

while in the lower scale he has encreased the azote to the length of 95, and the oxygen to no more than 5.

## CLXXVIII.

Next to vital air the dephlogisticated nitrous air falls to be noticed, in its effects upon the animal system. These effects are of the most singular kind, and eminently distinguish it from every other chemical agent. Formerly it had been supposed, with most of the other gases, noxious to animal life; but this arose entirely from the impurity of the gas employed. When pure it is breathed with safety, and attended with the most animating powers, that pervade every part of the system. It operates as a most active stimulant, every fibre is excited to action by it, a sense of thrilling is produced over the whole body, the most pleasurable sensations are experienced, the faculties of the mind are roused. A state of high exhilaration prevails. This is succeeded by no languor or debility, but a degree of vigour rather ensues, and a desire to exertion which gradually, after a certain time, subsides. Such are its effects either when breathed pure, or mixed with atmospheric air. In the former case, however, it can only be continued for four or five minutes at a time, otherwise from its high stimulant powers, insensibility would be induced, for an animal confined in it dies even sooner than in vital air, from the high excitement it occasions. It promises, however, to be a remedy of high powers in the treatment of many diseases of debility.

## CLXXIX.

The use of the unrespirable airs has also been attempted, and the effect of some of these shall next be noticed.

Hydrogen air may be cautiously employed, mixed with three or four parts of atmospheric air : of this mixture inspired for a few minutes, the result is in cases where diminished action is required, as in inflammation of the lungs, with pain, full pulse, and flushed face, that relief is in a few minutes experienced. The same has been found equally beneficial in croup, and in the last stage of the disease, as a powerful palliative of phthisis. In general it produces at first a slight degree of nausea. It acts as a powerful anodyne in inducing sleep.

## CLXXX.

Fixed air should not be used in greater proportions to atmospheric than from  $\frac{1}{3}$  to  $\frac{1}{2}$ . In this proportion it relieves phthisis, and is particularly useful in the dyspnoea to which it attends. It has even been proposed to use it in the day, and the former air, as an anodyne, at night. Of the modifications of fixed air, the use of the hydro-carbonate requires much precaution. Of all the gases it produces the most depressing effect, even in a proportion of 12 parts of atmospheric air, to 1 of it. The extremities have been chilled on the very first inspiration of it, and this weakening effect has continued for long after.

## CLXXXI.

To facilitate the application of this subject to medicine, it is proper to examine next the methods of employing these gases, or producing them with most ease and convenience; and this has been particularly pointed out by Mr. Watts, and is detailed at large in Dr. Beddoes's essays. }

## CLXXXII.

CLASS II. *Waters.*

The next class that follows the consideration of airs or elastic bodies is the waters formerly defined. They may be divided into simple water, and its various impregnations.

## CLXXXIII.

*Simple Water.*

Water, when pure, is tasteless, inodorous, colourless, and transparent. It is 850 times heavier than air, and though long considered as an elementary body, chemistry has been able to decompose it as well as others.

## CLXXXIV.

From this decomposition water is found to be a combination of oxygen and hydrogen, and the direct proof of it is brought by subjecting 15 parts of hydrogen to combustion in a close vessel with 85 parts of oxygen, when water is the product formed, and that in weight equal to the gases employed. Many other processes produce the same effect, where their principles are combined, and again separated.

## CLXXXV.

This fluid enters into the composition of most bodies in the animal, vegetable, and mineral kingdoms, either in a state of combination or simple mixture. Hence the ancient philosophers supposed that all things were derived from water, and they must have had a very extensive view of the operations of nature, for the dew, the clouds, the rain, the snow, and other meteors, all consist of water, and the numerous tribes of animals and vegetables all

arise out of it. When water is taken away nothing remains but the solid parts of the globe. But even these shew that the water has been, at least, the agent employed to arrange and dispose them into their present condition into the regular disposition of the materials of which we find them formed, into extensive beds, parallel to one another. This shews that the arrangement is the consequence of the disposition of the materials from water, and we are still more truly fixed in this opinion when we reflect upon the numerous relicts of the productions of water, and of the sea which are found in these strata. Hence it has even been attempted to be proved that water furnished the materials itself.

## CLXXXVI.

Water, we find, exists in three different states: in that of a solid, as in ice; in that of a liquid, its most common form; and in that of vapour or gas.

*Ice.*

The first is its natural state. It takes place at the temperature of 32 of F. and the phenomena observed in its passing into this state are; 1. a sensible production of heat at the moment the water passes into the solid form, which shews the escape of caloric to effect this; 2. its being favoured by exposure to the open air; and, 3dly, its being facilitated also by the agitation of its parts allowing the more rapid escape of its caloric.

## CLXXXVII.

Ice then is water in the crystallized form, and in consequence of this form it acquires elasticity. Its taste assumes more of a saline caustic nature, and its gravity is

lessened. As it passes into the liquid state, which is at some degrees above 32, it produces cold by the absorption of a portion of heat, and hence the practice of the fusion of ice, to procure additional cold for different purposes.

## CLXXXVIII.

Fluidity, the second state, is the more common form in which water is presented to us, and its properties in this state we are chiefly to consider. This state depends on encrease of its temperature, by which a considerable quantity of heat or caloric becomes fixed in it, and it is prevented from passing into a state of vapour by the pressure of the atmosphere.

## CLXXXIX.

In this state water is very seldom pure, for from its strong solvent powers, it has been termed the grand solvent of nature. From the degree of admixture it receives, it becomes more or less wholesome to the human body; and we shall examine it therefore, first, in its more simple, and 2dly, in its impregnated state.

## CXC.

Pure water then, as commonly used for domestic purposes, we consider as nearly the same, unless subjected to the process of distillation, when it is procured in the least tainted form. Thus spring, snow, or rain water, collected at a distance from houses and distilled to two-thirds, will be sufficiently pure for any purposes.

Rain water is very like distilled water, if collected at a distance from houses; but even at a moderate distance from houses the smoke which settles upon the tops of hills is washed off, and renders the water impure, so as to pos-

sefs even a strong taste and smell. On other occasions the stamina and dust of flowers and plants thrown up into the air, descend with the rain, and taint it. Springs which are originally produced from rain water falling in the higher grounds, and penetrating through the soil, find their way through strata of sand, till they are stopt in their descent by more solid strata, when they are moved horizontally till they come out in low grounds; and, according to the different soils they pass through, they turn out more or less impure. The waters of rivers and lakes are necessarily infected with animal and vegetable matter, especially rivers running from mossy grounds, which are generally tinged with a deep brown colour, by an infection of matter from the putrifying moss or turf.

## CXCI.

The most impure water is that of morasses and stagnating pools. These abound with large quantities of animal and vegetable matter, particularly living insects in great abundance, and those have given occasion to a mistake, with regard to such waters, that it was suddenly converted into blood. There is an aquatic insect, which is sometimes produced in great numbers, so as to give a thickish consistence to the upper surface, and it has a red colour. From this cause has such a vulgar idea been at times entertained.

## CXCII.

The most common division of water for domestic uses, is into hard and soft. A water is said to be hard when it does not dissolve soap, but renders the surface of the soap greasy, and it is a long time before any of the soap

can be dissolved, which rises in the form of a greasy scum. Such waters are unfit for boiling vegetables, and it depends on a portion of acid set loose, which acts upon the alkali of the soap. Soft water, again, is the opposite, or possesses admixture in such a slight degree as not to show any of these effects.

## CXCIII.

From a comparison of different waters, which are reckoned good, it would appear that water is not reckoned hard if it contains less than 10 grains in the pound weight of these materials. If it contains that quantity, or a little more, it possesses the qualities of hard water.

## CXCIV.

The 2d division of water, containing its various impregnations, is a subject of much importance; few bodies, as already observed, are exempt from its action. It absorbs small quantities of the simple gases, and is also dissolved by them, nor can they be entirely freed from it. Hence its strong attraction for oxygen on every occasion. It absorbs also atmospheric air, from which it becomes sparkling, and is rendered also lighter on the stomach. But its impregnations with the mineral kingdom, are mostly employed for the purposes of medicine and mineral waters, the term distinguishing such impregnations, may be divided into the hot and cold springs. Between these there is no very precise limit. We find springs of all the different degrees of heat from 48 to boiling water, but those not sensibly exceeding 58 are reckoned cold springs, and all the rest hot ones.



## CXC.V.

The admixture of substances which form mineral waters, is very various; but the arrangement is to be made from the predominance of one particular ingredient. Thus they have been divided into the acidulous, saline, sulphureous, and ferruginous waters.

## CXC.VI.

*Acidulous Waters.*

The first class are those in which the carbonic acid gas, or fixed air, is most prevalent. They are known by their briskness and pungent acidulous taste. They boil with facility, and afford bubbles by simple agitation. They redden also the tincture of tursole, and precipitate lime water, and alkaline sulphurs. This quality, however, they discover becomes very soon lost, the carbonic gas flies off, and they are preserved in perfection with great difficulty.

## CXC.VII.

All such waters, besides this predominance of carbonic gas, possess also always more or less of an alkali, and calcareous earth; and from these ingredients they are found to acquire various degrees of temperature; hence they have been divided into two orders, of the cold acidulous, and alkaline waters, and of the hot or thermal, acidulous, and alkaline waters.

## CXC.VIII.

*Saline Waters.*

The 2d class are those waters in which a neutral salt is most conspicuous, and this they show by acting strongly on the human body as a purge. They are to be regarded

therefore as salts suspended by a natural solution. The salts most commonly found in such waters, are the Epsom salt, the marine salt, and calcareous and magnesian muriates; but the proportion and number of these vary so much that they admit no distinct arrangement.

## CXCIX.

*Sulphureous Waters.*

The 3d class comprehends the sulphureous waters, or those which discover sulphur to the smell, and also have the property of discolouring silver. This substance is found to exist in them in two states, either in the form of sulphurated hydrogen gas, or in a solution of alkaline or calcareous sulphur, and they may be divided into two orders corresponding to these different states.

## CC

*Ferruginous Waters.*

This class is the most numerous of all the mineral waters, and in it the ferruginous principle, or iron, predominates. From the manner, however, in which this solution takes place, ferruginous waters are divided into three orders; 1st, The martial acidulous, in which the mineral is dissolved by the carbonic acid; 2d, The simple martial, in which no excess of acidity prevails to detect this solvent; and, 3d, The sulphureous martial, in which is contained the sulphate of iron. The impregnations of this class are not confined to the mere solution of iron, but they possess also an admixture of calcareous and saline matter, though their principal medicinal property depends on the iron.

## CCI.

To ascertain, with precision, these principles in mineral waters, various tests are employed, and the manner of applying for this purpose the most common of them, we shall prosecute in the order of the arrangement.

1. Acidulous waters are detected by an infusion of litmus, which turns the water red, and afterwards, when boiled, returns it to blue, or by paper stained in litmus, which is reddened when wet, but becomes blue when dry.

2. Saline waters are discovered by turning infusion of violet green, which thus shews the presence of an alkali, and calcareous earth is detected by a solution of lead in nitrous acid, which the water immediately precipitates, so as to produce a muddiness.

3. Sulphurous waters are known by turning infusion of litmus red, and by blackening polished metals.

4. Ferruginous waters are distinguished by blacking infusion of galls, and the dissolving acid is ascertained by observing whether it produces its effect before or after

## CCII.

Such then is the composition of water, and its principal impregnations in its second or fluid form; but it is presented also in a 3d state, or that of vapour, when it acquires new properties distinct from what it displays in its two other forms. This form or vapour was already considered (XXXVII) as an effect of heat, and it is evident that a true distillation of water is every where carried on at the surface of the globe. Thus it is raised by the heat of the

fun ; in that form it remains suspended a certain time in the atmosphere, and afterwards falls down in its liquid state under the name of dew. By this means the atmosphere is freed of these combinations, which by their corruption or developement might render it infectious, and hence also the unwholesomeness which is found to attend the evening dew. To this cause is referred also the formation of clouds in the higher regions, when in consequence of cooling or compression, the caloric separates from the finely divided particles of water which formed the basis of vapour, and which now approximate to return to the liquid state and descend in rain.

## CCIII.

Waters are a class of bodies of the first importance in medicine, and they are equally important to the preservation of health, as the obviating disease.

## CCIV.

Water enters largely as a constituent part into all animal and vegetable bodies. It forms the solvent or basis of all the fluids of every living and organized texture. Its proportion in the animal fluids is rated at nearly  $\frac{1}{2}$ , or as 90 to 128, though this quantity will no doubt vary with the circumstances of the health of the animal. It continues also at all times the least animalized part, while circulating in the system. Hence the loss of it is easiest supported, and also most readily repaired. Two of the excretions seem particularly intended for its removal from the system. These are the perspiration and urine. The former, in its natural state, contains nothing but water, with a small pre-

portion of salt, either to the taste or smell, and only under an encreased action, does it acquire seemingly an animalized state, as displayed by its peculiar odour. In the excretion of urine, the proportion of simple water is also great, and rated at about  $\frac{1}{2}$ <sup>6</sup>/<sub>8</sub> to  $\frac{4}{3}$ <sup>8</sup>/<sub>0</sub>, though it is more liable to variation, from different circumstances, than the former. Thus water is the principal solvent for all the alimentary matters the body receives, is the basis of all the secretions and excretions it performs, and enters largely as a constituent part into its general fabric.

## CCV.

The first effect of water we find to be facilitating the process of digestion, by holding in solution, and conveying in a form fit to be acted upon, the materials of solid animal food. Along with this it forms also itself a necessary aliment, and retains the due proportion of solid and fluid parts, necessary to the preservation and well-being of the system. Dilution, therefore, though not necessary in a great degree in stomachs possessing much activity or tonic power, is highly necessary where the powers are somewhat impaired, as preventing the chemical action of the contents of the stomach on the organ, and as hastening their passage into the intestines. That a certain proportion of it however is required for the due performance of the several secretions and excretions cannot be doubted, and an excess will always be less dangerous than the reverse, especially when we consider that the animal fluids are gradually becoming unfit to remain in the body; and in order to their regular removal they require a timely substitution or supply. To examine the subject however properly, the na-

ture of the food and state of the stomach deserve to be attended to.

## CCVI.

In all cases of thin watery food, it is clear little dilution is required, and where the food is not of a very stimulant kind. Hence vegetable food demands less of this beverage or solvent than animal. Animal food is also liable sooner to these spontaneous changes which render it unfit to be retained, and its excess of nourishment requires also its quicker exit.

## CCVII.

The state of the stomach is an important consideration in the choice of aliment. When weakness prevails in this organ from any cause, dilution is of great consequence, and this dilution should even consist in a previous preparation of the food in the liquid form, so that less action may be required in assimilating it.

## CCVIII.

As a remedy in disease, the use of water is equally important as in health. In acute diseases an excess of solution is always of the first importance. It is peculiarly marked as a characteristic symptom, by the thirst that attends, and it is generally desired of the lowest temperature that can be procured. In dwelling on this subject, therefore, the quantity and temperature are the chief points to be descanted on.

## CCIX.

In all cases of acute disease, both solids and fluids are equally affected. The encreased force of the solids requires a supply to keep their action from being hurtful, and

this supply is best afforded by water, for it also bestows the necessary fund to prevent the morbid state the fluids are under this action liable to assume. By a proper supply of water the febrile action will be lessened, the process of perspiration restored, and the increased heat connected with its obstruction diminished. Nor is there any danger of that temporary plethora, which has alarmed some writers, unless the water is suddenly thrown in and where of course it acts on the stomach alone. Where large dilution is to take place, it should always be done in divided doses, and its activity should be even increased, or the passage of the fluid accelerated, by its junction with such mild remedies, as will give it a tendency to pass off by the excretions.

## CCX.

The temperature of the diluent is equally important, as its quantity, and the degree of cold to which water, either as a drink or a bath, may be carried, is in direct proportion to the degree of animal temperature above the natural standard, and this again is proportioned to the vigour of the body, and to the strength of the disease.

Where the power of the stomach is strong, the degree of cold may be greater, which will increase the force of re-action, relax the extreme vessels, and occasion a freedom of perspiration to ensue, while in order to take advantage of this circumstance, the cold stage of fever should be avoided, and this re-action attempted, during the hot fit. For in the cold stage the dilution should be hot, and in the sweating one, tepid, or of a mild temperature.

## CCXI.

In chronic disease, the use of water is of equal benefit as in the acute, and for this purpose it is necessary it

should be chosen as soft as possible, and as free from adventitious mixtures. The effects produced by the use of hard water have not been fully ascertained; they have been supposed indeed as the cause of calculous complaints, though this is by no means sufficiently established. In considering water as a drink, we are to judge of it entirely by the degree of its solvent powers; and on this idea, soft water is certainly to be preferred, as all animal, vegetable, and saline matter is easier dissolved by it out of the body than by the other. Indeed in many instances hard water is known to produce dyspeptic symptoms in them that possess an irritable state of the stomach, particularly women and children.

## CCXII.

On these accounts the softer water is to be used as a medicine, and it will be found particularly useful in affections of the stomach and bowels: these complaints originate for the most part in irregularities in diet, particularly from excess. Though abstinence is, in many cases, the proper remedy, yet few patients can be found capable of submitting for any length of time to strong privations of accustomed indulgence. In place of it, therefore, nothing can be substituted so useful as a proper supply of diluents, as they correct the cause from which the disease proceeds, as far as it can be done. The constant and habitual addition of a large quantity of water, in divided doses, is therefore the best prescription that can be offered. It will remove the effect of excess of aliment, as well as its too great stimulus, and wash off any morbid irritation it leaves behind. Other remedies will be also found always rendered more successful, by being joined with it.



## CCXIII.

Nor is its temperature in this case to be neglected. In all chronic diseases it should possess a temperature nearly equal to animal heat. Delicate and irritable stomachs require this, in order that the process of digestion may not be interrupted, and the weak action of their stomachs rather impaired: a pain of stomach, the effect of crudities, is often entirely removed by warm water.

## CCXIV.

The good effects of simple water drinking have been long observed on the duration of life, and water-drinkers have been proverbially regarded as long livers. The permanence of their health, the regularity of their appetites, and the force of their intellectual powers, have all been circumstances taken notice of and descanted on.

## CCXV.

But the use of water, externally applied to the human frame, is equally beneficial, under certain circumstances, as its internal exhibition, and this includes the subject of cold and warm bathing.

## CCXVI.

By cold bathing is understood, the application of water to the surface or skin, in a temperature much below that of the animal heat, and in this degree it is an agent capable of producing very powerful effects on the system, and from the temperature alone these effects of it arise.

## CCXVII.

The salutary effects of cold bathing consist entirely in the power of re-action the system possesses, or in the degree

of returning warmth which succeeds the first shock or sensation of cold. Beyond this period it should never be continued, whether used in health, or as a remedy against disease. This requires to be particularly kept in view, as from the power of water in conducting heat, a continuance in this cold medium for any time rapidly exhausts the powers of life.

## CCXVIII.

The exertion of swimming strongly exemplifies this fact, which in this climate can be employed only for a very short time, while in the warmer climates, where an increased temperature of this medium prevails, no such debilitating effect is experienced from it.

## CCXIX.

Peculiar habit or constitution especially of the surface has at times a material influence on the application of this power. Thus the effect from the degree of temperature and the state of constitution will be counteracted by it, and this is strongly displayed in the attendants of cold and sea baths, who remain for hours under its impression without feeling any hurtful consequences from the diminished temperature.

## CCXX.

Sympathy between the external and internal surface, is also another circumstance that regulates the effect of the cold bath. In the delicate and irritable, this sympathy produces the most uneasy sensations when the water reaches the level of the stomach; and in order that it may be endured, every precaution must be taken to render the first impression in such cases as slight as possible, till a full immersion has taken place.

## CCXXI.

The changes conspicuous in the pulse deserve also to be noticed. An irregularity and quickness frequently ensue, previous to the immersion; when the latter has taken place, the pulse becomes slow, regular, and in general small, and this continues, and even increases so long as the immersion is persevered in.

## CCXXII.

The morbid affections to which this remedy is applicable, are numerous. Late experience has proved its success in the case of fever; and as an excess of heat and diminished perspiration are the leading symptoms of this disease, its application, under judicious regulations, cannot fail to be of the most sovereign efficacy in counteracting these symptoms.

## CCXXIII.

The chief regulations to be attended to, are

1. That the heat be steadily above the natural standard.
2. That it be applied during the hot stage, and when no chillness prevails, and
3. That there be no tendency to perspiration, as shewing a relaxed, weakened state of surface.

## CCXXIV.

The success of this means of cure, is displayed by a copious and general discharge by the skin, attended with a reduction of the febrile heat, and of the strong marks of the reaction of the system.

## CCXXV.

In chronic diseases the use of this remedy requires even more caution than in the acute, and here it is its tonic power alone that is called for. The chronic diseases in which it succeeds are these, of simple weakness, languor or nervous relaxation, where no permanent obstruction of any part or visceral disease is present. In these, if the degree of temperature is proportioned to the power of reaction the constitution possesses, the best effects will follow this remedy.

## CCXXVI.

The tepid bath, the 2d external form of this application, is not so common in this country as the cold one. By it is understood every degree of temperature above 92, which the skin can bear. It is a safer remedy than the cold bath, and is particularly adapted to weak and irritable constitutions, whom the shock produced by cold immersion would overpower, and who also have not the vigor of habit necessary to reaction.

## CCXXVII.

The diseases to which this form is beneficial, are equally numerous as the other. To complaints of the stomach and bowels it is well adapted, and colic and intestinal obstructions are powerfully relieved by it. Nor has it less influence in affections of the skin. Where the perspiration is checked, or any organic derangement produced, in consequence of its relaxing influence, if not curing, it prepares the way for the use of remedies with success. In the diseases of children it forms a useful and safe application, as the sympathy between the skin, and ali-

mentary canal prevails in them in a high degree, and diseases in them are generally lodged in this last situation. In all diseases attended with a loss of nervous energy, it forms a remedy of the first importance. Hence its utility in palsy and all the modifications of this malady.

## CCXXVIII.

These form a few hints on the general application of water to the human body; in health, as a solvent and constituent part of the system; in disease, as a remedy powerful in removing irritation and obstruction especially where confined to the first passages, nor is its external application, as we have seen, less beneficial. Laying aside then its simple state, we are to examine its various impregnations, and the superior efficacy it acquires from this source: in doing which, it is proper to consider the principal mineral waters in use, according to the arrangement formerly made.

## CCXXIX.

*Malvern Water.*

One of the simplest of the acidulous waters is the Malvern in Worcestershire. It is particularly used as an external application in scrofulous affections, and cutaneous diseases. It is also useful internally in cases of ulceration, and hectic fever.

The effects of this water at first are some degree of drowsiness, vertigo, and pain of head, which soon go off, and may be hastened by a slight purge.

The operation of this water on the bowels is uncertain. It however produces a flow of urine, and an increase of appetite.

## CCXXX.

*Bristol Water.*

A more powerful acidulous water is the Bristol hot well. The sensible effects produced by it, are at first a gentle glow in the stomach succeeded by a slight degree of head-ach and giddiness, which soon go off. By its continued use, the flow of urine is increased, and at the same time the skin is kept more perspirable, and the appetite and general health are improved. The effects of this water on the bowels are by no means constant, but in general a tendency to costiveness arises from their use. In taking them the quantity should be limited and never carried so far as to produce oppression or weight at stomach.

This mineral has been celebrated in a variety of disorders, and much of its success seems to depend on its increased temperature. In pulmonary consumption it is chiefly useful in alleviating the symptoms of hectic, and in order to produce its effects it requires a considerable length of time.

## CCXXXI.

*Matlock Water*

Is less powerful than the Bristol and chiefly used internally from its mild temperature. It has nothing particular besides to recommend it.

## CCXXXII.

*Buxton Water.*

Buxton water is employed largely both for external and internal use. The analysis of it shows the presence of carbonic acid, but more strongly of azotic gas. As an internal medicine it possesses great activity and of course success

in the cure of many diseases. In deranged symptoms of stomach and alimentary canal it has been found of great benefit, particularly where these symptoms are the effect of indulgence and high intemperance. Thus a judicious use of them will often relieve the uneasy symptoms of heartburn, flatulency, and sickness; and from a due perseverance in them, an increase of appetite and regularity of the secretions will ensue. On the bowels the waters appear to produce various effects. Not unfrequently a spontaneous diarrhoea comes on from their use for some days, which is attended with beneficial consequences, but constipation is a more common effect of their operation, especially in sluggish habits. For complaints of the kidneys and bladder these waters have been supposed of sovereign efficacy, and more especially when such complaints are attended with much pain and irritation. They have been recommended in gout; but here they are of more ambiguous operation, and the chief thing to be studied in this disease is temperature in the use of them. This water has been particularly prohibited in cases of active inflammation, and where a strong determination prevails to the lungs. This arises from the supposed heating qualities of the waters, and therefore it is more suited to the use in those acute diseases, and those especially in which there prevails little vascular action.

The external use of the Buxton waters as a bath differs in nothing from the common tepid bath. Its temperature is at 81, and it gives therefore little or no shock at immersion, while its application is succeeded by a highly glowing and pleasurable sensation over the

whole body rendering it warm and unctuous. It is well suited as a bath to the delicate and irritable, by whom much cold cannot be endured, and where the degree afforded by the Buxton water is yet sufficient to produce that reaction which forms a salutary effort of the constitution. But its use has been more particularly confined to affections of limbs where a loss of action or sensation has taken place. Thus chronic rheumatism is much benefited by it, and it may afterwards be succeeded by the common bath, or one of a lower temperature.

## CCXXXIII.

*Bath Waters.*

THE BATH waters have been more celebrated than most others. When first drawn they are quite clear and colourless, and remain quiet, without any bubbles or other appearance of effervescence. By standing in the open air the water acquires in some hours a turbidness, and a pale yellow ochrey precipitate descends from it. The quantity is small, and the liquid becomes lighter, and the turbidness ceases. Afterwards, without any further precipitation. No perceptible colour takes place from this water, except in large quantities, when a pungency reaches the nose; but neither ferid nor sulphureous. When not from the pump, the water, at the mouth with the impression of a chalybeate, but on cooling this is lost, and gives place to the taste of a saline impregnation resembling what is termed hard water. The Bath water is of a hot temperature, and when first drawn is from 112 to 120. Its chief ingredients to which it owes its activity are the carbonic acid, and ætolic gas. On account of the high repute of these waters, they have been much resorted to, and they have



therefore been more examined and commented on than most others. This water, when drank fresh from the spring, has in most persons the effect of quickening the pulse, increasing heat, and exciting the secretions. These symptoms ensue soon after its use, and with certain habits leave for a considerable time an evident proof of its continuing nature, and of a peculiar stimulus excited in the nervous system. It possesses also a strong tendency to pass by urine, and by this operation of it, it is supposed to have a salutary tendency. On the bowels its effects are uncertain; but in general a costive habit is the consequence of its use as of most other remedies whose action is determined to the kidneys or skin. When proving beneficial, its first effects are to excite there a pleasing glow, soon succeeded by an increase of appetite, exhilarated spirit, and copious urinary discharges. Where the reverse of this ensues, and fever, head ach, and sickness arise from its use, the continuing it is not advisable. But the external application is often of more service than the internal exhibition, and where it possesses a preference over common water of the same temperature, this may be ascribed to the greater equality of temperature which the natural bath possesses over the artificial, and to the constant aqueous vapour in which the patients are kept immersed.

## CCXXXIV.

The diseases for which this water is had recourse to, are numerous and important, and it is generally drank as well as externally applied. In all cases where a gentle, gradual, and permanent stimulus is required, it is highly proper, particularly where nothing is to be apprehended

from the temporary fever it creates. Hence in all acute inflammations it is justly condemned. Chronic diseases form in general the field of its successful action; and of these in none is it found more beneficial than in chlorosis; and its external use in this case favours strongly its efficacy as an internal medicine. That debility, the effect of long residence in a warm climate, and which produces obstruction in the biliary secretion, and an impaired state of the functions of the stomach and bowels, receives general relief from a course of the Bath water; and on the same principle jaundice is often cured by it. That chronic state of weakness which succeeds constitutional diseases, and is attended with loss of motion, pain, and various nervous symptoms, finds particular benefit from this remedy. Hence it is the general resort of the gouty and rheumatic patients, when tired out with the inefficacy of other medicines; and in this last stage of disease they certainly often derive from this water considerable advantage. In all situations indeed where warm bathing is useful, or where a tepid diluent is beneficial, the Bath waters rate high in estimation; and therefore in cutaneous affections, hypochondriasis, and many other similar maladies, their character has been long established. At all times they require a proper and fair trial, nor till long persevered in can success be expected. This is indeed gradual; and they even require at times an intermission of their use, which should be resumed and occasionally discontinued, as circumstances indicate.

## WATERS.

## CCXXXV.

## SALINE WATERS.

*Epsom Water.*

This water is transparent and colourless ; and after some time leaves a bitter salish taste on the tongue. It does not lose by exposure to the air ; and, on examination, is found to contain about 5 drams 1 scruple of residuum to the gallon. This residuum contains about  $\frac{1}{2}$  of sulphated magnesia, mixed with a few muriats of lime and magnesia, and the remainder is selenite. A half pint of water, therefore, contains less than a scruple of Epsom salt. This water is well adapted to that uneasiness of stomach which is attended with pain, tightness, and indigestion. In hypochondriacal cases it is also a useful purgative ; and when the menses are about to depart in the female, and health becomes irregular ; the use of this water is attended with the best consequences. In the same way they are useful to the sedentary and plethoric, who have turned the meridian of life, and to those whose system is loaded with impurities, and shews a scorbutic taint, or what has been termed so.

## CCXXXVI.

Of the same nature with the Epsom water are a variety of saline springs in the neighbourhood of London ; but from the smallness of their saline principle they are very uncertain in their operation, and they require to be taken largely, to render them effectual as purgatives. For this reason sea water is perhaps preferable to any of them.

## CCXXXVII.

*Sea Water.*

Sea water, at some distance from land, is in appearance

quite clear and colourless, void of smell, and shews no marks of any unusual quantity of air of any kind. To the taste it is highly salt, nauseous, and bitter. It becomes soon subject to putrefaction, and this probably from the solution it holds of animal and vegetable matter. In regard to temperature, this water is much more uniform than any inland water, and as commonly used by us on the coast it is never lower in temperature than 40 in winter, and never rises higher than 65 in summer. The proportion of salt it holds in solution varies in different places; but in general, on our coast, it is  $\frac{1}{4}$  of its weight, and its specific gravity is 1.0289. Its composition is muriated soda, in the proportion of near three parts, muriated magnesia one part, and sulphurated lime in a still smaller proportion.

## CCXXXVIII.

One of the principal effects that succeeds the taking of salt water, is considerable thirst, and what is peculiar to its operation as a purgative is, that it may be continued for a length of time without much debilitating the system. It is used in all those diseases where saline waters are prescribed; but its external application is much more extensive than its internal exhibition.

## CCXXXIX.

In being employed as a bath, the sea is beneficial in all those situations where cold bathing is admissible, and that is where no general inflammatory symptoms appear. In these situations it displays a considerable stimulus upon the surface, and this stimulus may be increased when necessary, either by mechanical means, as dashing from a height, or by increasing its temperature.

## CCXL.

One of the diseases for which sea water is principally employed is scrofula in its various forms. But its good effects are confined to the first stage of the malady, and before hecive symptoms of any kind have appeared. Both the topical, as well as internal use, should take place in such cases; and in this way both its discutient and healing powers will be apparent. But whenever sea water is at all employed internally, it should be made to produce evacuation, and it should be persevered in for a length of time; for it is only by patience and perseverance, in many cases, that it proves successful.

## CCXLI.

*Seltzer Water.*

Seltzer water is a saline mineral, perfectly clear and pellucid, and of a sparkling nature. It is somewhat pungent to the taste, and is gently saline and alkaline. Its pungency becomes soon lost by keeping it, and as this decays its alkaline flavor increases. From the analysis of this water a superabundance of carbonic acid distinguishes it; hence its acidulous taste, and it soon putrifies, and becomes fetid in the open air. The effect of this water, when drank in moderate doses, is to raise the spirits and increase the appetite; and though no way determined to the bowels, it shews a strong influence as a diuretic. The reputation of the Seltzer water has been very great in a variety of diseases. It is esteemed particularly serviceable in some affections of the lungs, and in the hectic fever that attends them. It is highly useful in cutaneous diseases, and in various derangements of the alimentary canal. It has been likewise highly commended in diseases

of the urinary organs, and the relief it gives them is often most remarkable. In hypochondriasis it affords at least, temporary alleviation, and removes the uneasiness and spasmodic state of the first passages often experienced. Less precaution is necessary in the exhibition of this than of any other mineral water; and as it is also recommended for a sensible taste and an agreeable flavor, patients are readily induced to go on with it for any length of time.

## CCXLII.

*Ferruginous, or Chalybeate Waters.*

Iron is the chief metallic body held in solution in water, and it imparts very sensible qualities to the fluid dissolving it. Of the chalybeate springs one of the first and most celebrated is,

## CCXLIII.

*Tunbridge Wells.*

This water, when taken from the spring, is quite colourless, clear, and bright, having no perceptible smell, to the taste it is slightly chalybeate, and by no means disagreeable. On standing some time exposed to the air, its surface becomes covered with scum, and it has lost its chalybeate property, which shews the carbonic acid the cause of solution.

## CCXLIV.

The use of chalybeate waters, in the cure of diseases, is a subject of the first importance. Soon after taking a moderate dose the pulse is raised in strength; the patient, if previously chilly and pale, feels a certain glow, occasioned by the increased circulation, and, by proper perseverance, the appetite is strengthened, and the spirits

improved : and this improvement takes place in various degrees, according to the constitution of the patient. On the first use, however, of chalybeate waters with many a number of unpleasant sensations arise, as nausea and sickness, pains of the præcordia, heaviness of head, and feebleness over the whole body. These symptoms being merely temporary, seldom require much attention, as they yield so soon as any increased excretion takes place. The effect of chalybeates is to blacken the feces, which every patient should know, to prevent any groundless alarm. Another constant effect of chalybeates is the production of constiness, which should be particularly prevented. Where such waters agree, an increased discharge always comes on under their use ; and this either consists in a discharge of urine or in a very perspirable state of surface.

## CCXLV.

The general operation of chalybeates is to increase the power of the secretory system ; and this takes place in that gradual and uniform manner which is attended with a permanence of stimulus that no way attends the use of other remedies. Debility and laxity of solid are the chief indications for their use, and when no marks of organic disease appear to counteract the success of their operation. Thus in the various states of dyspepsia, the use of chalybeates is of eminent service where atony forms the source of the malady. In the diseases of the female sex they have acquired the same reputation, particularly in chlorosis, and in that debility which is often the cause of abortion.

## CCXLVI.

Such is the general effect of chalybeates as powerful tonics. They are superior to most of the medicines of this class, but in their exhibition a proper discrimination is required. It is in weakness chiefly, without local derangement, that their success is conspicuous.

## CCXLVII.

*Spa Water.*

One of the most powerful chalybeates is the Spa water. It is a chalybeate in which the carbonic acid is in excess, and it is therefore strongly acidulous. It remains longer unaltered by the air than any of the other mineral waters. It is also fatal to aquatic animals, which marks its strong carbonic impregnation. The sensible effects of this water are more stimulant than any of these hitherto described, and from the commencement they painfully affect the head, and produce symptoms of vertigo. When taken in hot weather, and in a full draught, this amounts to actual intoxication, and sometimes continues for half an hour or upwards at a time, producing the same state as arises from the use of ardent spirits: but differing so far as not being succeeded by the same debility. The regular determinations of this water is to the kidneys and skin; sometimes they affect every secretion, and not unfrequently the bowels are powerfully affected by them. They readily quench thirst, and prove useful in ulcerations of the throat, the effect of relaxation. In increased discharges from the primary passages they give material relief in removing pain and irritation, and thus they contribute to the restoration of a healthy state. In all sexual diseases, the effect of debility, they are highly



useful, and in the same way, in all consequences of preceding disease, wherever seated, where these consequences are the mere effect of relaxation, they produce a state of tone and vigour. On the same principle, wherever an inflammatory habit prevails, or local congestion is prevalent, their use is forbidden.

## CCXLVIII.

*Pymont Water.*

This water, when taken from the spring, is quite clear and transparent. It has a sensible pungency to the smell, and produces giddiness in the water servers. Its taste is highly agreeable, being strongly acidulated, and in its briskness it resembles Champagne wine. It retains strongly, at the same time, the chalybeate bitter impression; and so powerful is its carbonic principle, as when corked, at times to burst the bottle. It possesses, therefore, all the property of this acid unconstrained, and in its most active state. Accordingly, when fresh drank, it is sensibly pungent to the smell, and produces temporary intoxication. At all times it enlivens the spirits, and increases the appetite. The effects of this water on the bowels are uncertain. It is sometimes briskly purgative, and always produces on the faces a dark colour; but its most common action is an increase of urine, and not unfrequently an eruption on the skin. Its powers over disease are the same with those of the Spa, and it is therefore to be used in all cases of debility, where an active tonic is required.

## CCXLIX.

*Cheltenham Water*

Unites the saline and chalybeate principle. Its action,

therefore, is powerful upon the bowels. When fresh drawn it is not perfectly transparent. By standing it becomes turbid, and separates bubbles of air. It possesses a slight sulphureous odour, very perceptible on the approach of rain. To the taste it is brackish, bitter, and chalybeate. From this account it contains very active ingredients. It does not keep nor bear transporting to to any distance, the chalybeate part being soon lost by precipitation, and in the open air it even turns soon foetid. The sensible effects produced by this water on first taking it, are a degree of drowsiness, and sometimes head-ach, but which pass off even before its operation on the bowels. Its operation as a laxative is highly salutary, producing neither griping nor sense of weakness, so that it may be persevered in for a length of time, without producing any inconvenience to the body; and during its use the appetite will be improved, the digestive organs strengthened, and the whole constitution invigorated. In small doses it is apt to pass off by the kidneys. This water is much used in a variety of chronic diseases. In the cure of glandular obstructions it is considered particularly beneficial, especially where their seat is the liver and alimentary canal. Thus it is the chief restorative for the injuries of a hot climate, in respect to the secretions of these organs, and even considerable debility in such cases is no objection to its use. The operation of this water is occasionally assisted by a junction of the warm bath. Cutaneous eruptions, of a chronic nature, are also much relieved by this mineral, where their appearance is occasional, and at stated intervals. In cases of simple debility or relaxation this water certainly yields to the

other chalybeates; but wherever there is obstruction or fixed local congestion, its exhibition is strongly indicated.

## CCL.

*Scarborough Water.*

Scarborough is another of the purging chalybeate waters, though not so active, in this respect, as the former. Its general effect, however, when taken moderately, is always to open the body rather than to pass off by any of the other secretions. It is employed in the same diseases as the former, and the same good consequences follow its exhibition.

## + CCLF.

*Hartfell.*

This chalybeate differs from the others in being held in solution by a fixed acid, the sulphuric. It is therefore a vitriolated chalybeate water. It is strongest after heavy rains, and it keeps for a long time unimpaired, shewing its ingredients to be of a fixed nature. For the cure of many diseases this water is a remedy of great reputation. Its first effects, when taken, are sometimes giddiness and sickness, especially in a large dose. Its operation on the bowels is irregular, a costiveness is most common from it; but sometimes there are gripes and diarrhoea. In all diseases of general weakness and debility, this will prove a useful remedy; and it has been therefore employed in complaints of the stomach and bowels, and in increased discharges of a passive nature, with decided advantage. Even in pulmonary consumptions relief has been obtained from its use. Nor is its benefit confined to internal exhibition. As an external

application it has proved highly salutary in old and languid ulcers, and checked the vitiated discharge, the effect of that debility of solid with which they are connected.

## CCLII.

*Sulphureous Waters.*

Sulphureous waters are such as possess a strong sulphureous smell, and the sulphur with which they are impregnated is united either to hydrogen or an alkali, so as to render them very powerful agents on the human body. Of this class there are considerable varieties, possessing also various degrees of temperature, but they all agree in their general properties. Thus they possess a fetid smell, a peculiar sweetish taste, at first unpalatable, but soon relished from habit. They cannot be transported to any distance without their ingredients being decomposed.

## CCLIII.

*Harrogate Water.*

This water, when first taken, appears perfectly clear and transparent, and sends forth a few bubbles, but not in any quantity. It possesses a strongly fetid smell, and a bitter, nauseous, and very saline taste, which is soon borne without any disgust. In a few hours of exposure this water loses its transparency, and becomes somewhat pearly, and rather greenish to the eye. Its sulphureous smell abates, and this ingredient is deposited as a thin film in the vessel in which it is kept. The volatile products of this water shew carbonic acid, sulphurated hydrogen, and azotic gas. The sensible effects which this water excites, are often a head-ach and giddiness on

being first drank, followed by a purgative operation, which is speedy and mild, without any attendant gripes; and this is the only apparent effect the exhibition of this water displays. The diseases in which this water is used are numerous, particularly those of the alimentary canal, and irregularity in the bilious secretion. Under this water the health, appetite, and spirits improve; and from its opening effects it cannot fail to be useful in the costive habit of hypochondriasis, which requires to render it soluble, a remedy of this mild operation. But the highest recommendation of this water has been in cutaneous diseases, and for this purpose it is universally employed, both as an internal medicine and an external application. In this united form it is of particular service, even in the most obstinate and complicated forms of cutaneous affection; nor is it less in states and symptoms supposed connected with worms, especially with the ascarides; and in order to prove successful here it should prove briskly purgative.

## CCLIV.

*Moffat Water.*

Moffat water, when first drawn, appears rather milky and bluish; the smell of it agrees with that of Harrogate; its taste is simply saline and sulphureous, without any thing bitter; it sparkles on turning it from one glass to another. The only sensible effect of this water is increasing the flow of urine, and it only purges after an excessive dose, which is more owing to the bulk of water than the mineral ingredients. The success of this water has been chiefly displayed in cutaneous eruptions, and the external application of it in an increased temperature, has

been equally trusted to, as its internal exhibition. Scrofula is also a disease for which it is alleged to prove a sovereign remedy. It is chiefly, however, in the earlier stages of this malady that it has afforded the most complete relief, and tumours have been dispersed by it without suppuration. In irritable ulcers it is used at the same time as an external application, nor are its effects confined to this disease, in bilious habits and dyspepsia it forms a frequent remedy, where a want of action prevails in the alimentary canal.

## CCLV.

*Aix La Chapelle Water.*

This water is at first perfectly colourless and pellucid. It sends out however a strong sulphureous odour, so penetrating in close weather as to strike the nose at a considerable distance. The taste of this water is saline, bitterish, and rather alkaline, and both the taste and smell are more powerful in proportion to its heat. On standing this water acquires a milky hue, and deposits an earthy sediment. By this deposition it loses much of its smell, and when cold retains scarcely any, which may be again renewed by heating it. This water is particularly distinguished by a vast quantity of sulphur it holds in solution; and it is this principle suspended in hydrogen to which it owes its activity. The sensible effects of this water are but few. It produces in general some cheerfulness and gaiety of spirit, but taken largely it affects the head, and brings on vertigo and sleepiness, and the more so if it is hot. It sometimes excites nausea from its strong smell and taste till the patient is accustomed to them; but this effect is merely temporary. In their operation these

waters prove mildly laxative, when liberally taken, though this is greatly determined by the state of stomach of the patient. The increased determination to the kidneys and skin is a more usual effect of their operation, particularly the latter; and this state is highly favourable in the disorders for which they are commonly used. During a course of these waters they impart a sulphureous smell, and silver in the pockets of the patient is tarnished. The diseases to which these waters administer relief are numerous; affections of the stomach and biliary organs are among the principal. Disorders of the kidneys and bladder attended with much irritation and mucous discharge, receive also benefit. They are regarded as improper in all active inflammatory states, and particularly where a hectic fever, diseased state of the lungs, or disposition to hæmorrhage prevails. These waters are even more extensively employed as a hot bath than as an internal medicine, and they are more medicated than any others in use. From their high temperature and sulphureous impregnation, they are powerfully detergent, and are found of particular service in stiffness and rigidity of the joints and muscular parts, particularly in the consequences of gout and rheumatism, and that weakness which attends palsy. In every cutaneous eruption they are of eminent benefit; and in this case the internal exhibition of the water should be enjoined. It is also a powerful tonic in that relaxation which succeeds a long continued use of mercury. This water is even so hot in its natural temperature as to form a vapour bath. In this form it is much more liable than in any other to affect the head, and occasion flushings of face, and other marks of deter-

unction to the head, which require a guarded use in applying it as a remedy. It is therefore only occasionally employed, in order to act as a powerful sudorific, and to assist the action of the other forms in obstinate cutaneous complaints.

## CCLVI.

*Borset Water.*

This water is near that of Aix, and resembles it. It is of a high temperature, and therefore chiefly employed as a bath, which is done in every form.

## CCLVII.

*Barege Water.*

The Barege waters have a slight taste and smell of sulphur. They have a smooth, soapy feel, and they render the skin, when immersed in them, very supple and pliable, dissolving soap and animal lymph. They are chiefly employed as a bath, and from their detergent nature joined with their temperature, they are considered to possess high powers in resolving tumours of different species, in rigidities and contractions of the tendons and joints, and likewise in removing cutaneous complaints. The warm bath is therefore used both generally and partially, in the form of douche. The internal use of this water is praised in disorders of stomach and bowels, connected with an acid course, and also in jaundice, in calculous complaints, and other affections of urinary organs.

## CCLVIII.

We have thus considered the principal medicated waters in use, detailed their leading qualities, and stated the principal diseases in which they are employed, with-



out entering into the particular ingredients of which each is composed. This will be better seen at one view, and is well arranged by Dr. Saunders in his late work on the subject, from which the present table is extracted. It will be only necessary to close the account with some general remarks on their contents and mode of operation —

**Medicated waters** are a remedy that act in two ways, 1st, As a simple water; and, 2dly, As an active impregnation. Their operation in the first way was formerly examined; and, as an active impregnation, although the quantity of medicine they suspend is small, yet from the manner in which it is diffused, the activity of its powers is much increased by the more extended surface to which it is applied; and its impregnation is presented in a form which medicine cannot otherwise so easily convey. This is evident from the complicated nature of the several impregnations. But the gaseous products appear the most useful parts of mineral waters. Their inhalation by the lungs was examined in the former class of bodies, and their application given in mineral waters is principally to the stomach. Hence the sudden relief they generally give to this organ, and hence their great advantage in all its complaints. By the temperature of the stomach their principles are unfolded in it, and they act with powers of which we can out of the body form no judgment, and thus the unexpected cures so frequently met with from their use. That their effects on the system at large, as well as on the stomach, are considerable, cannot however be denied, and this appears proved by the sulphurated hydrogen which is smelt under a course of these waters. Every circumstance

indeed shews that mineral waters are a mode of combination of the powers of medicine, in a manner superior to what can be accounted for from their known ingredients, and a mode of exhibiting medicine, which is therefore superior to every other in most chronic diseases. All the carbonated chalybeates are much increased in their powers by their height of temperature; and of all solvents the carbonic acid seems the most proper for this mineral. The same takes place in the sulphurated waters with respect to temperature, by increasing it their powers are rendered much more active. This effect is less conspicuous in the saline waters, which depend more on dilution than temperature.

## CLIX.

CLASS III. *Inflammables.*

Inflammables formerly defined, possess a principle different from that of the two classes hitherto examined, and this principle exists, in its most simple state, in three substances, carbon, sulphur, and phosphorus, the combination of which with oxygen forms acids.

## CCLX.

*Carbon*

The diamond and charcoal are the two chief sources of carbon. In the former it exists in a separate state; in the latter it is more compounded. By combustion of the former in oxygen by the solar rays, pure carbon has been obtained.

## CCLXI.

*Diamond.*

This substance is distinguished from every other by its

eminent lustre, density, hardness, and transparency. It is found crystallized, generally colourless though sometimes otherwise, and of a varied appearance. Its specific gravity is from 344 to 355, and it is acted upon by no chemical agent but oxygen, at a high temperature. When placed in oxygen gas, and exposed to the solar rays concentrated, its color first becomes dull, and its surface sensibly blackened. When the application is continued, it at length faintly inflames, and requires the continued application of the same power before it is reduced.

### CCLXII.

#### *Charcoal.*

Charcoal is a black, sonorous, and brittle substance obtained from the combustion of wood, conducted in such a manner, that the free access of the air is not permitted, the constituent principles of the wood are disengaged in new combinations, and the charcoal is the residuum. This substance, unless when red hot, is unchangeable and incorruptible. Hence the common practice to scorch the ends of stakes that are to be driven into the ground, to make them durable, and it has a surprizing effect. We meet with bits of wood so charred, lying at considerable depth in the ground, which are undoubtedly of very considerable antiquity, and the structure is no ways changed; it not only resists the effect of air and moisture, but the most penetrating matters, nor has any thing been found that acts upon it so long as it remains cold.

### CCLXIII.

This substance is tasteless and inodorous. It is extremely porous, and from this porosity is capable of ab-

forming large quantities of the gases, without suffering any change of its properties. When heated to the temperature of ignition in contact with atmospheric air, it burns with a red or white flame, according to the rapidity of the combustion, and with the extrication of a large quantity of caloric. In oxygen its combustion is much more vivid, and by this it is generally consumed. The product is an acid, the saturation of carbon with oxygen. Charcoal, therefore, is a compound substance, containing carbon with a proportion of oxygen.

## CCLXIV.

Another substance which contains also this principle is the plumbago, or black lead. It is of a black color, foliated texture, soft, and somewhat unctuous to the touch. It is not altered by exposure to air or water, nor is it altered by fire, so as to be used in making crucibles and furnaces. By long ignition, or intense heat, it is resolved into the carbonic acid, with a residuum of iron. It consists therefore chiefly of carbon and oxygen.

## CCLXV.

The substances termed incombustible coal, resemble plumbago in their difficulty of burning, and they require also a larger quantity of oxygen than charcoal for their saturation. The charcoal of animal substances is only combinable with oxygen at a high temperature.

## CCLXVI.

*Sulphur.*

Next to carbon, the 2d simple inflammable body we mentioned is sulphur. It yields a peculiar odor when

heated, and on being rubbed manifests electric powers. It is found in abundance in nature, in various states, or both pure, and in a state of mixture.

Native sulphur is either crystallized, or in compact masses, and in both forms it is found in the neighbourhood of volcanoes. It exists also combined with the metals, and from the combustion of it with iron, it is extracted for the purposes of commerce. Sulphur thus obtained is freed by sublimation from its impurities, and in this state is termed flowers of sulphur. Sulphur is also contained in small quantities, in several vegetable and animal products.

#### CCLXVII.

Sulphur is naturally tasteless and inodorous. Its specific gravity is 199. It is insoluble in water, and melts at 223 of Fahrenheit, and at the same temperature it is volatilized.

#### CCLXVIII.

##### *Phosphorus.*

The last of the simple inflammable bodies is phosphorus. It combines with oxygen at the lowest natural temperature, and its product is a peculiar acid. In the mineral kingdom it exists, combined with several of the metals and earths, and it is a component part of many animal products.

#### CCLXIX.

Phosphorus, in its pure state, is of a flesh colour, and of the consistence of wax. It is at first transparent, but becomes white, and in the sun yellow. It has a specific gravity equal to 1.914. It melts in water at the tempera-

ture of 99. When exposed to atmospheric air, it emits a white fume of a fetid smell; and in the dark it is luminous.

At the temperature of 100 its combustion is rapid, and at 160 it burns with a white flame, and with the emission of a large quantity of caloric. Its combustion in oxygen gas is highly vivid, and it emits a great quantity of light. Though consumed in atmospheric air by a slow process, it requires in oxygen the assistance of heat.

## CCLXX.

Such are the more simple inflammable bodies; and proceeding on the predominance of this principle alone, without regard to their separate qualities or origin, we next consider those inflammables of a more compound nature.

## CCLXXI.

*Alcohol.*

The first of these that claims attention is alcohol, or as it is commonly named, ardent spirit. This kind of body has its name of spirit, according to the practice of chemists, who give it to all the liquors afforded by distillation, and of ardent or inflammable, to distinguish it from the saline and other kinds of spirits. It is also termed vinous from its origin; and in its pure state, rectified spirit of wine: or when still farther purified, alcohol.

## CCLXXII.

This liquor is distinguished by possessing an aromatic and resinous smell, a penetrating hot taste, and an intoxicating quality.

## CCLXXIII.

Its origin is from all vegetable matters that possess a sweet or saccharine substance, which, when dissolved in water, and allowed to ferment, produce a liquor, that afterwards, subjected to distillation, is alcohol. The constituent principles of this liquor are carbon and hydrogen, in intimate union.

## CCLXXIV.

This liquor differs somewhat in its qualities, according to the particular vegetable matter from which it has been prepared; and from its being mixed more or less with some oily matter, it acquires peculiar kinds of taste and flavor.

## CCLXXV.

To obtain it perfectly pure it requires repeated distillations, so that its water and oily matter may be thoroughly extracted; and this may be also facilitated by certain additions during the process. These consist in a mixture of dried carbonate of pot-ash, and to remove the flavor of the alkali thus acquired by it, a small proportion of alum is added to the last distillation.

## CCLXXVI.

By such means alcohol of a pure kind may be obtained; and while the specific gravity of this liquor is to water as 815 to 1000, it may be brought even the length of 791. This is generally determined by the hydrometer, or by its residue of water after combustion. Pure alcohol is colourless and transparent, and is possessed of several remarkable qualities. It is one of the most difficult bodies to freeze of any we know. There is hardly any

fluid so much expanded by heat or contracted by cold. At 174 of F. it is converted into vapour, and it evaporates spontaneously, very fast, and is in every respect a volatile fluid. In vacuo it is converted into vapour, in a heat below any of the heats of our atmosphere; and on this some phenomena of the pulse glass depend. It consists of a head, tube, and ball, sealed up with a quantity of spirit of wine, enough to fill one of the balls and a small part of the stem; and when held in the hand, with the one end a little higher than the other, the spirit of wine begins to boil.

## CCLXXVII.

But the chief quality of this fluid, as already noticed, is its great inflammability, which it remarkably displays whenever approached by flame, burning with transparency, and without the least appearance of smoke. From the products of its combustion the proportions of its principles are ascertained, 100 parts of this fluid being composed of 2.5 of carbon, 7.8 of hydrogen, and 63.5 of water; so that it contains less of the principle of inflammability than any other substance of this class.

## CCLXXVIII.

This fluid can be mixed in any quantity with water, in which it differs from other inflammables; but the specific gravity of the combination of the two is never the mean of the specific gravities of the respective fluids being always greater. This combination is accompanied with a diminution in the capacity for caloric, and hence a rise of temperature always attends it. The combination of alcohol with water, in an equal quantity, forms proof spirit.



## CCLXXIX.

*Oils.*

The next compound bodies of an inflammable nature are oils, whether vegetable or animal; and the inflammable substances in animals and vegetables are of an oily nature, and differ only in their degrees of fusibility.

## CCLXXX.

Of vegetable oils there are two kinds, the expressed or fixed, and the essential or volatile. The former are generally contained in the seeds and fruits of vegetables, at the period of maturity, being extracted by mechanical pressure, or by decoction in water. They are frequently impregnated with the mucilaginous or extractive matter of vegetables, whence they acquire colour, taste, and odour. In their pure state they are insipid and inodorous, and lighter than water. Their consistence is thick and unctuous, and even at times concrete, or they are easily rendered so by cold.

## CCLXXXI.

Expressed oil is equally insoluble in water and alcohol, nor can be volatilized by heat, without a change; in which case it becomes more mild and limpid, separating a part of its constituent principles. Exposed to a warm atmosphere, this body acquires a sharp taste and disagreeable smell. It is also altered in consistence. This change depends on the absorption of oxygen, termed rancidity; and it can be rapidly produced in it by its exposure to vital air.

## CCLXXXII.

At the point of ignition, oil is converted into vapour, and burns in atmospheric air; and the consequence of

this combustion is the extrication of a large quantity of light and caloric. When the access of the air to the ignited oil is not complete, a black smoke arises, and a quantity of carbon is deposited. To prevent this, in the forming of candle, a slender wick is proper, which draws up the oil by capillary attraction, and readily converts it into vapour or else a hollow wick, which allows a circulation of air through it.

## CCLXXXIII.

The products of the combustion of oil are chiefly water and carbonic acid. Thus a pound of olive oil contains about 12 ounces of carbon, and above 3 ounces of hydrogen.

## CCLXXXIV.

The second class of oils, or the volatile, is odorous, rapid, and generally pungent; it varies in its colour, consistence, and odour, and is chiefly obtained by distillation. This oil is mostly of vegetable origin. There are few oily principles found in animals that belong to this class; but in vegetables there is a great variety, and all the vegetables in which we can distinguish a sensible odour, are of this kind. It forms the most useful principle of their composition, and is therefore termed their essential oil.

## CCLXXXV.

Essential oils differ from one another in many respects; but many of them have not been found applicable to useful purposes, and others cannot be extracted but with an expence exceeding the value that can be set upon them.

## CCLXXXVI.

The other qualities possessed by essential oils, besides odour, are, that some of them are very fluid, light, vola-

tile, and subtile; others of them are more heavy, requiring more heat to convert them into vapour. Most of them, as observed, affect the tongue with a sensation of a sharp, acrid, and burning taste. Some are milder, so that it is difficult to give any general rules respecting their qualities. The only one is with regard to their weight, that in the colder latitudes they are lighter than water; in the hot they are so heavy as to sink in that fluid. But even this rule is far from being just; for the same oil appears in different states in this respect, as in distilling cinnamon. When distilled with a gentle heat, it floats on water; but if the distillation is conducted with a strong heat, it sinks: so that the rule would appear to be drawn from the dry spices from the East and West Indies, in which the oil is thicker, from the evaporation of the thinner parts.

## CCLXXXVII.

Essential oils are preserved with difficulty long in perfection, and the only way is to keep them in vessels, with glass stoppers, carefully bound, which are to be kept in a cool place, and seldom opened. They become less fragrant, less fluid, and of a darker colour, which change happens more quickly when they are exposed to the air, from their absorption of oxygen; and they frequently deposit, in consequence, crystals of an acid nature. To restore them to their former state, it is common to distil them with water, in a gentle heat.

## CCLXXXVIII.

The distinguishing property then of essential oils is their volatility, so that in the heat of boiling water they raise visible steams, and evaporate copiously. This vola-

tility is gradually impaired by keeping, as in the oil of turpentine, which suffers it very quickly. Distilled with water, a portion of essential oil is procured, much improved, while what remains is thicker, darker, and less odorous, and the volatility can be increased beyond what it was at first. The diminution of the oil is most apparent without water, each time a small portion of the water separates, and a thick resinous matter remains, or carbonaceous substance, and by degrees the whole of the oil is decomposed.

CCLXXXIX.

Essential oils, when heated in contact with atmospheric air, are more easily inflamed than the *exprest* oils. Thus with the oil of turpentine, the wick of candle is prepared for lighting quickly. They yield also more water by their combustion. Hence they contain a larger proportion of hydrogen than the *exprest* oils, which is perhaps the cause of their greater volatility and inflammability.

CCXC.

Essential oils dissolve in water, in a certain proportion, so that their more volatile and odorous part becomes combined with it, and the fluid, in consequence, acquires a degree of the pungent taste and odour of the oil, and displays a whitish appearance.

CCXCI.

In their action with the simple inflammable substances, the oil of cloves produces a liquid with phosphorus, which emits a luminous vapour; and when it is rubbed upon the skin of the hands or face, it makes them appear luminous. These oils also dissolve sulphur, reduced to a fine powder, the oil being heated. The solution is of a red colour, and:

acquires a thicker consistence; it is called balsam of sulphur, of which there are several kinds.

## CCXCII.

The relation of spirit of wine or alcohol to these oils, is also worthy notice. It dissolves most of them with ease, and in considerable quantity, forming a transparent homogeneous fluid. This is the case with all the aromatic oils, without exception; only some can be dissolved in greater quantity. The spirit of wine has a greater disposition to dissolve those that are thick and resinous, than the more fluid, subtile, and volatile. A separation of the oil, in this solution, is easily made by the addition of water. By distillation of alcohol with these vegetables containing essential oil, distilled spirits are formed, which are the most delicate preparation; distilled with water, more of the oil is dissolved; distilled with spirit of wine, its fragrant part only is carried off.

## CCXCIII.

These oils of vegetables are secreted juices, lodged in particular vessels; sometimes in the bark, as in cinnamon; sometimes in the root, as in the plant that yields the true camphor; sometimes in the wood, as cedar; sometimes in the leaves, as mint, balm, sage; sometimes in the flowers, as the moss-rose; sometimes in the seeds or fruit, as in a great variety; sometimes in the bark or rind, as in the oranges and lemons, of which the external surface is quite rough, with little cells that contain the aromatic oil, which can be burst by squeezing the rind; and if this is done opposite to a candle, the oil is thrown across it, and forms so many jets of flame.

## CCXCIV.

In general, they are extricated by means of heat, and distilling them with water; and in doing this the vegetable should be macerated for some time in the still, with a proper quantity of fluid, and then distilled with a moderate heat. During the maceration the water penetrates, and opens the little repositories, and the heat of the boiling water converts the oil into vapours, which are carried over more copiously by those of the water than they would otherwise rise of themselves; so as soon as the water is condensed it becomes milky, the oil condensing along with it, in minute drops collected into larger, which rise to the surface, or fall to the bottom. This operation is the only means of applying heat to vegetables, in order to extract the oils of this kind; for their volatility is but moderate, requiring the full heat of boiling water to convert them into vapour; and we cannot apply this heat to all the parts of a vegetable substance in any other way than by immersing it in boiling water. It is put by itself into the still, before the upper part of it is in due degree of heat, and by the water the heat is raised to the degree necessary to convert the oil into vapour over the whole of the substance, at the same time; and these vapours that would ascend more difficultly, are pushed over more quickly by the ascending vapours of the water. It is true that a necessary consequence is, that a proportion of the oil is dissolved by the water, which it is impossible to recover again; but when the operation is done for the sake of the oil, the same water can be employed in the next distillation, and the water is capable of receiving only a

certain quantity of the oils : so it will dissolve more of the oils of the second parcel.

## CCXCV.

From some vegetables, as lemon and orange, this oil can be obtained in a mechanical way, ~~as~~ being lodged in the rind ; and that by either squeezing the rind, so as to burst the cells that contain it, or by rubbing the rind upon a loaf of sugar, the roughness of which breaks up the cells, and the oil is imbibed by its pores. The sugar thus moistened may be scraped off, and this operation continued, till a proper quantity of oil is obtained, mingled with the sugar ; and this may be very useful on many occasions, as the sugar is not an unfit ingredient to be added to the mixture, in which these oils are commonly used.

## CCXCVI.

*Camphor.*

This is a substance that possesses properties that are considered by chemists as peculiar. That it is an aromatic oil is plain, from the greatest number of its qualities, and also from its origin. It is produced from a sort of laurel, a native of Japan. It is deposited in particular vessels, as the aromatic oils are ; and it is extracted in the same manner, by exposing it to the heat of boiling water. It is likewise deposited from several essential oils, when they are long kept.

## CCXCVII.

Camphor is solid and tenacious, of a white colour, and semi-transparent. It possesses a strong fragrant odour, and a warm pungent taste, like the aromatic oils.

It is so volatile, that it quickly loses weight when it is exposed to the air; and at a very moderate increase of temperature, it sublimes unchanged. It appears to be a volatile oil, rendered concrete by carbon, and therefore highly inflammable. It is easily soluble in spirit of wine, and easily separated again from it by water. It unites with sulphur, in a gentle heat, and its relation to the saline bodies fall to be afterwards considered.

## CXCVIII.

*Balsams and Refins.*

Under this division of aromatic oils may be comprehended also the balsams and refins, as nearly resembling them. They are found in various vegetables, and are secreted juices, deposited in particular vessels of the plants.

## CCXCIX.

In general, when applied to the tongue, they produce the sensation of taste with more or less pungency and heat. They are all more or less inflammable, and produce much soot during their combustion.

## CCC.

Refins are oils rendered concrete by their combination with oxygen. Balsams are refins combined with essential oil, and a principle convertible by oxygen into an acid, of the benzoic kind.

## CCCI.

Both substances dissolve readily in spirit of wine, and are again easily separated by water, in which they resemble the essential oils. The chief distinction is in the degree of fluidity and volatility. Many are extremely solid and



very hard. The greater part of the balsams have a sensible degree of fluidity; some of them are nearly as fluid as some of the essential oils, while the resins are solid and brittle. In the ordinary temperature of the air with heat, they melt into an oily fluid, not to be distinguished from what is called a balsam; some are brown, some reddish, some more transparent, and their degree of fluidity is various. Indeed the same individual balsam varies in its consiſtency, by degrees. If long kept, unless pains are taken to confine the volatile parts, it suffers a dissipation of them.

## CCCII.

In spirit of wine these substances are, in general, more soluble. Boiled in water, they are in part converted into vapour, and disperse their odour all around. If the vapour is condensed, they form a perfectly fluid, fragrant, volatile, aromatic oil, while the remaining matter is less odorous than the balsam was at first. It varies, and is commonly found to be changed into a perfect resin, and brittle in the ordinary heat of the air. If this is submitted to inflammation, there is obtained a small quantity of aromatic oil; but as the greatest part has little volatility, the heat scorches and changes the arrangement of their particles, forces off oily vapours that are called empyreumatic, and leaves a residue of carbonaceous matter.

## CCCIII.

A great variety of vegetables contain balsams and resins; some of them are more soluble in spirit of wine, and some are difficultly soluble in it. Hence the different kinds of them, according to their different degrees

of transparency, want of colour, &c. prove useful in a variety of arts.

## CCCIV.

The balsamic and resinous substances are, in general, secreted juices, and are found in the parts of the vegetable. The process, by which they are found, is not the same with that employed for the oils. The general manner in which they are obtained, is by cutting the vegetable in different places, so as to occasion the juices to be shed by bleeding, and it even happens spontaneously, in consequence of an overfulness of the vessels occasioning them to burst. These juices issue out as fluid as an aromatic oil; but issuing out but slowly, they suffer an evaporation of their more subtile parts, and gradually increase in thickness and consistency, till they acquire the consistence of a balsam, or the solidity of a resin.

## CCCV.

There are many of these substances that are applied to various purposes in the arts, as well as being made use of in medicine. Many of them that are of great transparency and hardness, when dissolved in spirit of wine, compose varnishes, which spread on wood, leave the resin, while the fluid that held it dissolved, is evaporated.

## CCCVI.

The expressed, or fixed oils already noticed, deserve, in concluding the volatile or essential ones, to be prosecuted somewhat farther in detail.

The most perfect oils of this class are mild, free of taste and smell, and unctuous and greasy to the feel. When compared with the aromatic oils, the greater num-

ber are sluggish and thick. They are lighter than water, and are more volatile than the aromatic oils, so that they do not so readily suffer the same change when exposed to the air; but if with the exposure heat concur, as that of the summer or of the blood, they acquire an offensive smell, a thicker consistence, and a great degree of acrimony. Thus they irritate the nervous system, and there is no substance which is more ready to produce noxious effects, when taken into the body, than oils in this state.

## CCCVII.

Such oils possess a great difference in their disposition to be affected by heat. They are not near so inflammable as the aromatic oils, and they have not the least degree of volatility in the heat of boiling water, or in some degrees above it. Neither can they be volatilized by heat unchanged. At a temperature below 600 of F. they remain fixed, but nearly at that temperature they are converted into vapour; but the oil thus condensed has lost its mildness, and has become more limpid and volatile, a portion of carbon being likewise deposited.

## CCCVIII.

Some artists have occasion to boil lintseed oil for painting; but it must be done in the external air, from the risk of the oil boiling over, and setting fire to the place where it is; but at the same time attention must be paid to the state of the weather, that it be clear, as the smallest drop of water falling into the oil, would make it boil over with the greatest violence.

## CCCIX.

Unctuous oils differ from the aromatic in their difficult

solubility, as they neither dissolve in water nor spirit of wine. With regard to inflammable substance, these oils dissolve phosphorus, and some of them form luminous liquids, like the aromatic oils. Sulphur is also dissolved by them. The oil is put into an iron vessel, adding  $\frac{1}{8}$  or  $\frac{1}{4}$  of the weight of sulphur. The oil is heated till the sulphur melts, when it communicates a darker colour to it. If  $\frac{1}{4}$  part is dissolved, it forms a gelatinous mass of  $\frac{1}{8}$  only; it is of the consistence of a balsam, and is called the balsam of sulphur. Oils cannot be made to dissolve charcoal, nor do they mix, as already observed, with spirit of wine.

## CCCX.

Some of the species of unctuous oils are distinguished by particular qualities. Some shew a little affinity with the aromatic kinds containing a volatile principle, the presence of which is necessary to their fluidity; and as it evaporates, the oil becomes solid. The upper part, from the absorption of oxygen, has a thick film formed on it. When these oils are spread on the surface of a body, as wood, they acquire a particular consistence, and compose a thin covering of a tough varnish.

## CCCXI.

*Spermaceti.*

Spermaceti is a concrete oil, extracted from a species of the whale. It is perfectly mild and insipid. It is indissoluble in water. It has a considerable degree of solidity, and not having the greasy softness of the other fats, it does not leave a greasy stain upon clothes; but when cold it can be rubbed off. It melts in heat below boiling water, and it congeals like water congealing

into ice ; and without passing into any intermediate state of softness, it forms a mass that is white, somewhat transparent like alabaster, and of a foliated structure, like talc. It is mixed with the fat of a particular species of the whale, is fluid in the animal, but congeals when exposed to the air ; it is separated from a quantity of fluid oil mixed with it, by colature, by putting the matter into bags, when the fluid oil is drained away, and exposed to a violent pressure, it is squeezed out ; the spermaceti is then found in the form of little transparent scales. It is next melted with a small quantity of caustic alkali, which unites with the remaining oil, and changes it into a soap, while the spermaceti is not disposed to unite with the alkali in the least.

### CCCXII.

Spermaceti burns with a very white flame, and rises totally, if distilled on a violent fire, assuming a reddish tinge, and losing its natural consistence by repeated distillations. Alcohol dissolves it by the assistance of heat, but lets it fall as it cools. Its solution takes place also by the fixed and volatile oils.

### CCCXIII.

#### *Bee's Wax*

Is connected to the fixed oils, in the same way as camphor is to the volatile. It is produced in the anthers of flowers, from whence it is collected by the bee. It is yielded also by the fruit and leaves, and is sometimes contained in their juices. It differs from spermaceti in having a greater degree of solidity. When distilled the greater part rises in an oily form, some part in the form

of a liquid oil, the greatest part having some degree of solidity, and the mass is then termed the matter of wax, and which has a less offensive smell than most of the empyreumatic oils. It is inflammable, and the products of its inflammation are water and carbonic acid; and from the quantities of these the proportions are calculated to be 13 parts of carbon and 2 of hydrogen.

## CCCXIV.

*Lac.*

A substance of a similar origin is lac. It is a kind of wax, collected by red-winged ants in the East Indies, from flowers, which they transport to the small branches of the trees where they make their nests. It is imported in small sticks, named stick lac. The branches of the trees are covered over with it to a considerable degree of thickness. It forms an unequal covering over the stick, of a dark colour or orange colour. It is full of cells, but more irregular than those of the bees, and at the bottom of the cell there are the remains of the insect; but it is prepared before it comes to the shops. The lac is beat off, and steeped in water, to extract the colouring matter which is used in dyeing. What remains is called seed lac, consisting of small grains into which the lac breaks when taken forcibly off the surface of the twigs. On other occasions the heat is applied to it in a greater degree, in order to get more of the colouring matter, which makes it melt. It rises to the surface, is then skimmed off the water, and cooled in plates of metal, when it is called shell lac.

## CCCXV.

This substance resembles bees' wax in several parti-

culars, but it has a greater degree of hardness. The greater part of it dissolves in spirit of wine, and forms a remarkably hard varnish, which is capable of receiving a very fine polish; but from its dark colour, it is incapable of being employed to stain works that have a variety of colours.

## CCCXVI.

Such are the chief remarks to be made on the fixed or unctuous oils, and on the substances that most resemble them. On their use and origin, it may be observed, that though the aromatic oils are most precious, the fixed oils are most valuable and useful. They are produced in great quantity, and hence are not high priced. They are a necessary part of diet in all parts of the world, in the form of butter from milk; of olive oil; from vegetables, &c. They also afford light in the night-time, and they are one of the conveniences that contribute to render some climates inhabitable. In Lapland they keep their habitations warm by means of them. The lamp constantly burning, is the principal part of the household furniture. They are necessary, as we shall find, in making soap and diminishing friction in machines, and many of them are useful as paints and varnishes, to defend wood from the air and water.

## CCCXVII.

*Animal Fat.*

Fixed oils are not confined to vegetable substances, but also abound in the bodies of animals. In fishes they form a covering, and preserve their heat in the dense and cold element they inhabit. These oils are immediately under the skin; they are both in vegetables and animals secreted juices; they are found in vegetables in different

parts, and they are extracted by various operations; generally by expression from seeds. Thus linseed is ground down to a meal, and exposed in a strong hair bag to violent pressure, and a little heat is employed to give a greater degree of fluidity and facility to the expression. In other cases, when it can be in some measure dissolved in water, the substances are infused in this fluid, as in the oil of olives, &c. The oil separates, and rises to the top, and all the oils of animals, as that in the cellular membrane, are soluble in water by coition; and this method is the most convenient for extracting them.

## CCCXVIII.

Animal oil, distinguished by the name of fat, is of a white colour, sometimes yellow, of an insipid taste, and of various consistence in different animals. It differs both in the individual, as well as in the part of the body which produces it. On exposure to the air it becomes rancid, from the absorption of oxygen. It is also decomposed by heat, and from this decomposition there is produced an acid liquor, an acrid empyreumatic oil, and carbonated hydrogen, having a residue of charcoal. The acid liquor has been supposed a peculiar one, termed the sebacic acid. When obtained pure it is fluid and colourless, has a pungent odour, and a sharp acid taste. It is decomposed by heat, carbonic acid being disengaged, and charcoal remaining.

## CCCXIX.

When oils are distilled with a heat above that of boiling water, so that they are made to assume the form of vapours, they never fail to undergo a change. They become highly acrid and stimulating, as well as fetid



and disagreeable. In this state they are termed empyreumatic oils, and are distinguished into four varieties, viz.

1. Those produced from the balsams and resins.
2. Those from the fixed oils.
3. Those from the vegetable substances that do not contain a formed oil. And
4. Those from animal substances that are not of an oily nature.

### CCCXX.

The first division has, along with the burnt and disagreeable flavour, some of the odour of the aromatic oil. The balsams and resins always give out a quantity of aromatic oil, which is mixed with the empyreumatic from the more fixed part of the resinous matter, so as to communicate some degree of the particular flavour.

The second division has always an odour more or less resembling that of the snuff of a candle or lamp; a quantity of unctuous oil continues to evaporate from the wick, and the steams affect our organ of smell.

The third division has more or less the odour of tar, and is not distinguishable from it; it is attended with the smell and odour of the wood that is burning.

The fourth kind has always an odour resembling that produced by the burning of bones, and other animal substances.

### CCCXXI.

These oils, as first distilled, are always dark coloured, and have a considerable degree of thickness and viscosity. They are easily soluble in spirit of wine, and miscible in some measure in water, and they want the lubricating

opacity of the unctuous oils. If they are repeatedly distilled they acquire a greater degree of tenuity, fluidity, and volatility, and the dark colour goes off. There are many of them that can be rendered as colourless, fluid, and volatile as spirit of wine. They then mix more readily with water, which acts chiefly on their more volatile parts. The most fetid of the empyreumatic oils are those from animal substances that are not of an oily nature. Some of them have been highly recommended in medicine, as powerful anodynes; but the trouble of preparing them, and the difficulty of preserving them, have made them be less attended to. They must be distilled five or six different times, and the oil put into a clean vessel each time, which is attended with considerable trouble and expence, as it is difficult to free the vessels of the thicker matter remaining after the distillation, and the excessive sœtor of the oil renders the operation very disagreeable; and when they are prepared, they are liable to depravation by keeping.

## CCCXXII.

But there are some kinds applied to more extensive uses, as tar. It is the empyreumatic oil of pine and of different kinds of fir trees. It is expelled from them by heat, and condensed hastily, so as to obtain the greatest quantity of this oil; and as these trees all contain a quantity of balsamîc matter and aromatic oil, the tar has that adhering to it.

## CCCXXIII.

*Bitumens.*

The last division of inflammable bodies comprehends the bitumens, which are generally of a strong smell, are fluid,

soft, or solid, and afford by distillation an empyreumatic oil. They are found in three states, exuding from crevices, floating on waters, or forming strata in the earth. They consist of the same principles as vegetable matter, of carbon, hydrogen, and oxygen; and there are often mixed with them the remains of vegetable matter. They arise, therefore, from the slow decomposition of vegetable substances lodged in the earth, or they depend on the action of heat, without the access of air.

## CCCXXIV.

*Naphtha and Petrolea.*

The naphtha is an oily liquor, limpid and colourless, of a penetrating smell, volatile, and highly inflammable, having a specific gravity of 708 to 847. It will burn on the surface of cold water, and it does it with a smoke like all other oils. A liquor of this kind is generated from particular springs and wells in Persia, and in the duchy of Modena in Italy. Others, inferior to this, more frequently occur under the name of petrolea, of a brown or black colour, and less agreeable odour, in various parts of Europe, in the crevices of rocks, in springs and wells. The asphaltus is another species of the same, solid and brittle, and altered, perhaps, by exposure to the air. It melts by heat and is decomposed, affording an empyreumatic oil, carbonated hydrogen, and carbonic acid. None of these varieties, when burnt, leave any earthy residuum.

## CCCXXV.

The bitumens, in consistence, resemble the vegetable balsams. Those of them that are more subtile than the kinds described, so rarely occur, and are so costly, that

few experiments have been made upon them. The more fluid ones float on spirit of wine, and readily dissolve in it. The thicker kinds derive their consistence from a greater proportion of solid matter. When distilled they become like the fluid kinds, acquire a greater tenacity, transparency, and volatility. Upon the whole, the different varieties resemble the empyreumatic oils, and are obtained by heat from the solid bitumens; of these there are two kinds.

## CCCXXVI.

The first is the amber or succinum, which is a bituminous concrete, of a yellow or brown colour, and more or less transparent. In its colour, however, there is considerable variety; some pieces being clear and transparent, some opaque and whitish, some dark coloured; the most valued specimens are of a pale yellow colour. On being slightly rubbed, it acquires electric powers; only a small portion of it is dissolved by spirit of wine. It gives the most remarkable phenomena when exposed to heat. Being rubbed, the odour of it that exhales resembles the aromatic resinous substances, and is increased. In a greater heat it acquires a brown colour, emits some steams, and undergoes a state of fusion. It then becomes quite dark and opaque, and it is employed in this state in the composition of some varnishes. At the same time it emits very penetrating vapours, burns with a greyish flame, and leaves a coaly residuum.

## CCCXXVII.

When this substance is distilled, the empyreumatic oil  
is mostly thick, and of a blackish colour, and  
has a heavy, penetrating odour. When it is repeatedly

distilled it becomes more fluid and transparent, and can be rendered quite limpid; in which state it is said to resemble the finer kinds of petrolea, particularly the naphtha. It is then termed rectified oil of amber.

## CCCXXVIII.

The origin of amber has been much disputed, whether it is originally a fossil, or is produced from vegetable matter. The only reason to imagine it is entirely a fossil body is, that it is found at some depth below the surface under certain strata. The greatest part that we have comes from the Baltic. A considerable quantity is found floating on the sea on these coasts, being washed out of the soil by the agitation of the waves, when they penetrate through different strata, first through one containing fossil wood, variously compacted together; under this a stratum of vitriolic minerals; below this the amber is found dispersed, in various sizes; but when it is examined, we find manifest proofs of its having been produced originally at the surface of the earth.

## CCCXXIX.

*Ambergriſe.*

The second of the solid bitumens is ambergriſe. It resembles amber in several chemical qualities. It is a light ash-coloured body found on the sea-shores in the East Indies. It is opaque, and of a granulated structure. It has a light agreeable odour, melts with a gentle heat, without suffering any change; and, if farther heated in close vessels, it gives an oil like that of amber. It also dissolves in spirit of wine, by means of heat, and is used in the composition of perfumes.

## CCCXXX.

The origin of this substance is uncertain. It appears to be somewhat similar to that of amber. It is found in masses, from one to a hundred ounces. The greatest quantity is found in the Indian ocean; but we also meet with it in our own and in the Northern Seas. It is found likewise adhering to the rocks, and in the stomachs of the most voracious fishes; these animals swallowing at particular times every thing they happen to meet with. It has been particularly found in the intestines of the whale, and most commonly in sickly fish, being supposed the cause or effect of disease. We often find in it relicts of animal and vegetable substances, the bones and beaks of birds, and insects; and as it resembles bees-wax, melting like it, it would appear that it has been originally bees-wax, which having been buried under the surface of the earth, or having floated a long time on the ocean, has undergone a considerable change; and we know the amazing quantity of bees-wax and honey that is sometimes collected by bees, in their wild state, as in America. In old trees quantities have been found, sufficient for filling several hogheads; and in rocks and caves along the sea-shore, quantities may be gathered together, and by being buried, or by floating on the water, they may undergo a change, so as to be converted into this substance.

## CCCXXXI.

*Coal.*

The last of the solid bitumens is coal, which is well known as a useful fuel. It is of considerable variety, and differs from the preceding substances in containing

earthy and carbonaceous matter; the different proportions of which give rise to its different varieties. It burns with flame and smoke, and leaves a residuum of ashes. Exposed to heat, in close vessels, it affords an empyreumatic oil, carbonated hydrogen, carbonic acid, ammonia, and sometimes sulphuric acid; the residuum is carbonaceous matter, and when burned to whiteness, its ashes are chiefly argillaceous earth, with oxyd of iron.

## CCCXXXII.

Coal is generally found in extensive strata, and the chief varieties of it are, 1. The common Parot coal; 2. The fat, or blacksmith's coal; 3. The-Kilkenny, or blind coal; and 4. The candle coal.

## CCCXXXIII.

The Parot coal differs from the fat coal, in being more inflammable, and in burning with a much more copious flame. Exposed to heat, in close vessels, it gives out a quantity of empyreumatic oil, which, by repeated distillations, acquires a great degree of tenuity. At first it is thick and very black, but it becomes light coloured, and so volatile as to take fire on the least approach of flame; on the surface of water thus resembling the naphtha and petrolea, which were formerly employed in the art of war, spread on the surface of water, and set on fire, in order to burn the enemies' ships.

## CCCXXXIV.

The fat coal contains a great quantity of inflammable matter; but in so volatile a state that it requires some art to blow it up, as it is disposed to undergo a sort of fusion. The small pieces unite, and concrete together.

This is a valuable property, and which renders the English coal so esteemed in commerce, because in the working and shipping it is not liable to any waste and decay. The dust of it proves just as useful as the solid pieces, whereas the Scots coal, of the common kind, is cut, disposed to bake together, and the dust of it extinguishes the fire, like sand. But these first unite together, in consequence of the partial fusion, and form large masses, which are afterwards broken, in order to animate the fire.

## CCCXXXV.

The blind coal is a sort of natural charcoal, as formerly noticed. By its external appearance it is not to be distinguished from the other coal; but in the fire there is a great difference. It does not give out the smallest appearance of flame, but contains the inflammable matter in a more fixed state. Exposed to heat, in close vessels, it does not give out any empyreumatic oil. Some change has been produced to form this coal, by the application of subterraneous heat upon coal of the common kind, as the dissipation of its more volatile part, and a vein of coal cinder is actually found near the town of Ayr.

## CCCXXXVI.

On examining the extensive strata of coal, we find every reason to conclude that it is of vegetable origin. We meet very frequently with appearances in it so much resembling those of the charcoal of wood, that there is no room to doubt that these masses have been formed from pieces of wood, that have undergone such a change as to give the appearance of charcoal. We see the fibrous appearance of the charcoal, and that it possesses the



qualities of it; and we observe that it is found in the neighbourhood of strata, formed by a disposition for water. At least, in this part of the world, considerable quantities of coal and free-stone are intermixed, which last is formed from sand, arranged by water. Besides we find large collections of wood, under the surface, still retaining its principle, as near Exeter in Devonshire; only it is so bituminous that it cannot be made use of for ordinary fuel, and is only employed for burning lime: and in no other parts do we find such amazing quantities of wood or trees, compacted together, so as to form very thick and extensive strata.

## CCCXXXVII.

These facts plainly shew, along with many other phenomena, that this globe has undergone great changes; that what was once above the surface is now buried at a great depth below, and what was at a great depth is now exposed to the air. So we find reason to conclude, with regard to the fossil inflammable substances, that they have all derived their origin from vegetables. We find traces of these in amber, &c.; and with regard to the fluid inflammables, they resemble the empyreumatic oils, and are probably produced by the destruction of inflammable substances, by subterraneous fires; and we find them in countries that abound with volcanoes, as in Italy, where the different kinds of naphtha and petroleum issue from the crevices of rocks, and float on the waters of particular springs, and the whole of the country has subterraneous fires at present, or the marks of fires that have existed before.

## CCCXXXVIII.

From this view of inflammable substances, we find, that their base consists of one of three simple bodies, carbon, sulphur, or phosphorus; and that these simple bodies are united with various extraneous matters. Thus diamond consists of carbon, in its purest state; charcoal consists of carbon, with a proportion of oxygen; plumbago is carbon, with a proportion of oxygen and iron. Proceeding farther, we find, alcohol consists of a union of carbon and hydrogen; that the oils contain carbon, in a very considerable proportion; that in the fixed oils it is combined with mucilage, and in the volatile ones with aroma; that camphor is a volatile oil, rendered concrete by its carbon; that wax is formed of carbon, in a large proportion; and that the bitumens consist also of a large share of this principle, with a contamination of earth and other matters.

## CCCXXXIX.

Sulphur, again, the second of the simple inflammables, may be considered as the grand mineralizing agent; and its combinations, therefore, will appear in a class of bodies we are afterwards to consider.

Phosphorus, the last of the three, composes the principal base of the hard parts of animals, particularly the bones, and is found in greatest abundance, and is most easily procured from the bodies of animals.

Thus each of them may be separately considered as the proper inflammable base of the vegetable, mineral, and animal kingdoms, though not exclusively confined to these.

## CCCXL.

We have thus examined the class of inflammable bodies,

both in their simple and more compound state. This class we find highly important in medicine ; of the simple inflammables, carbon and phosphorus enter largely, as constituent principles, into the animal body ; and of the compound substances, the unctuous oils do the same.

Carbon is that principle which is the base of vegetable matter, and which is transferred to the animal body from that source. Its extrication, therefore, by the process of respiration, is gradually and constantly taking place, by the absorption of oxygen decomposing it, in order to allow complete animalization to ensue, and the real animal principle, or azote, to prevail.

Phosphorus, again, is a particular constituent of the bones, as carbon is of the softer parts ; and they consist almost entirely of phosphate of lime, with a fibrous parenchyma.

Sulphur is contained in very small proportion in animals ; but, at the same time, it is much used in medicine.

### CCCXLI.

As a medicine, sulphur is distinguished by its insolubility in the animal fluids, by its specific action in psoric affections, and by its power of diminishing the activity of other medicines of a metallic nature. The first arises from its entering so little, as a constituent part, into the principles of the animal body ; the second is a consequence of its highly penetrating and diffusible nature, acting as a powerful stimulus on the extreme cutaneous vessels, and hence applied in any manner it is equally effectual ; and the third is by reason of its abstracting from such metallic remedies that part of the oxygenous principle

which gives them oxydation, and on which their activity depends.

## CCCXLII.

Carbon has of late been introduced as a medicine, in its compound state, or in the form of charcoal, against internal hæmorrhage and external ulceration. In the first case it is given in powder, and will no doubt be successful in arterial hæmorrhage, by lessening action, and abstracting that principle to which the change of the fluid in its passage through the pulmonary vessels, is owing. In ulcerations of an irritable, painful nature, it will soothe uneasiness, and dispose to the formation of fibrine, or solid, in the part.

## CCCXLIII.

Alcohol is a fluid largely employed in medicine, both simply and as a solvent of other substances. It possesses highly stimulant powers, and imparts their active principle to all the variety of wines of vinous and spirituous liquors in use. Its proportion in these different liquors varies; but its operation is always to affect the nervous system in a powerful manner, and to induce that debility, as a secondary effect of its action, which we term intoxication, and which powerfully undermines the springs of life. The dietetic use of alcohol, in its different forms, has thinned society more than either pestilence or the sword; and the impaired constitution of modern age marks strongly the baneful consequences of its influence.

## CCCXLIV.

Oils, the next division of this class of bodies, are much allied to the animal constitution. Those of the volatile

kind are chiefly used in the form of distilled waters, or combined with alcohol, termed spirits, as rendering it more agreeable. Their operation, therefore, on the body differs in no respects from it, and cannot be considered as having, in the small proportion in which they are combined, the real operation of an oil. The fixed oils, however, admit a more general application, and they are employed in medicine largely, both externally and internally. By their lubricating and emollient qualities they remove tension, pain, and spasm; and by their chemical combinations they may be considered as acting farther, and lessening the activity of the oxygenous principle, in certain states of disease. Thus, when the decomposition of carbon and hydrogen is too rapid, by the different excretions and absorption of oxygen is in excess, oils will be properly used, to lessen this effect. In some climates they are both employed largely in diet, and also their external application to the surface, is attended with the most salutary consequences. Too little observation, however, has been made on this subject, to enable us to form any full opinion respecting it. In all cases of abrasion of surface, the use of oils, in the form of unguent, has been very general; but they are more suited to the active inflammatory states of local disease than to the chronic; and in the latter they do not even form, in a great number of cases, a proper medium for the application of other remedies.

The use of oils has been lately recommended in one peculiar disease, which has baffled the healing art, hydrophobia; and it is recommended both internally, in liberal doses, and also to be applied externally, by general and strong friction of the surface.

In all cases where oils are used internally, they require to be taken in a combined state; the stomach is unable to digest them pure.

## CCCXLV.

Camphor is one of the most powerful remedies in medicine, and it is used both externally and internally, in a variety of disorders. From its connection with the essential oils, it is clearly, in small doses like them, a powerful stimulant. Hence in solution it forms a successful rubefacient, in cases of external pain or spasm. In large doses, however, it becomes a useful sedative and antispasmodic; and for this purpose it is employed for urinary affections, particularly where irritation arises from the absorption of cantharides; in which case it is said to act like a charm. In contagious disorders, as putrid fever, it has proved also a strong antiseptic; but to its sedative qualities in mania, much more has been ascribed than to any other remedy; and that success has here frequently attended its exhibition there can be no doubt.

## CCCXLVI.

The resins and balsams are equally external and internal medicines. The latter have been considered as specific in ulcerations of the lungs and urinary organs; the former are more heating and inflammatory. The use of both is much circumscribed in modern practice.

## CCCXLVII.

The use of spermaceti, formerly in much repute, is now little employed in medicine. Its only quality is as a softening remedy in soothing irritation; hence it is

exhibited wherever abrasion of the passages takes place, as in catarrh, or ulceration of parts, particularly of the lungs and urinary organs. The chief objection to its use is its difficult combination, and its afterwards lying heavy on the stomach.

Bees-wax, and all the other kinds of wax, are chiefly used externally, in combination with the oils, in the form of unguents, cerates, and plasters. It is sometimes, however, formed into an emulsion, in chronic dysentery, with success.

Lac is never employed in medicine but as a colouring substance, and its chief use is to tinge sealing-wax.

#### CCCXLVIII.

Amber is esteemed in medicine a powerful antispasmodic, and is used in a variety of forms, as we shall afterwards find, in a number of nervous disorders.

Ambergise is solely employed as a perfume.

With the petrolea, external friction is recommended in rheumatic and paralytic cases.

#### CCCXLIX.

On the whole, the class of inflammables afford a set of remedies of powerful operation; but though agreeing in one general principle, they differ very much otherwise in their secondary properties.

#### CCCL.

#### CLASS IV. *Salts.*

The next class of bodies, or the saline, is perhaps the most numerous of any one, from their strong tendency to combination. They consist all of oxygen, fixed in combination with some combustible body, and water is often

present, without being an immediate part of their composition.

## CCCLI.

Of this class of bodies, their solubility in water is their leading characteristic, as formerly observed (VII.) ; and in dissolving them certain phenomena are found to occur.

## CCCLII.

These phenomena consist in

1. A separation of air ; 2. A change of temperature ; and 3. An increasing slowness of solution.

## CCCLIII.

In regard to the first, the dissolving fluid becomes milky or muddy, and little globules of a gaseous form appear on the white surface of the liquor.

On the second, it is observed, that the temperature is sometimes diminished, and depends on particular circumstances attending the solution, as afterwards noticed.

In respect of the last, the facility of solution is always greatest at first, and gradually lessens, till it arrives at its ultimate point termed saturation ; and this power is prolonged, or the quantity dissolved augmented, by two circumstances, agitation and heat. By the last of these, or an increase of temperature, a larger portion of salt can be made to dissolve, though it is apt again to separate on the fluid losing this temperature.

## CCCLIV.

Salts are divided into two kinds, the simple and compound, and these possess either a solid or fluid form.



## CCCLV.

The effects of heat on both kinds is very similar, producing their expansion and even conversion into vapour, and, in a low degree, their consequent condensation, &c.

## CCCLXVI.

When in a solid form, their attraction for water is so great, that exposed to the air they attract it, prove it, and run into deliquium, or become deliquescent. The degree of solubility, however, they possess, or tendency to deliquesce differs in different salts; and the quantity dissolved before saturation take place, is influenced by the circumstances already recited.

## CCCLVII.

The liquefaction or solution of salts, produces, as already mentioned, a change of temperature, wherein the salt is in a solid form, like that of all solid bodies, their solution produces a degree of cold; and the same also happens when the water is in a solid state, and the salt, on the contrary, the reverse. In dissolving, however, all the fluid salts the opposite of this, or a degree of heat is produced; and the same also takes place, when in consequence of their union with water the latter assumes a solid form, and likewise when the salt, being in the form of elastic vapour, is by this union condensed.

## CCCLVIII.

All salts, whether possessed originally of a fluid state, or rendered so by solution, may be reduced to a solid form, and this is performed by evaporation; and according to the degree of evaporation they receive, two species of this process arise, the first termed *evaporation*

*to dryness*, when a brisk heat is applied to the fluid, and continued without interruption till it is entirely exhaled, after which the salt is found to constitute a white spongy mass, the parts of which are too small to discern their figure; and second, crystallization, when it is performed only to a certain degree, or what is termed, to a pellicle; and the water remaining not being sufficient to retain the salt dissolved; on the mixture's cooling, the latter separates in part, and clings in the form of angular masses, which from their transparency, are termed crystals.

## CCCLIX.

It is in this last state that salts have been chiefly considered; but it is by no means their pure state, as they contain always a quantity of water combined with them; and to this they owe that quality they possess, when heated to a certain degree of decrepitation, the water contained not being sufficient to produce on them the watery fusion; but when converted into vapour, it escapes in this way, with noise and explosion.

## CCCLX.

Another peculiarity in the solution of salts is, that the same fluid, when saturated with one salt, will dissolve another; and even afterwards dissolve more of the first salt, the one increasing the solubility of the other. The consequence of this compound solution is often a strong combination of the salts dissolved; but in other cases not—a separation from such compound solution may be effected in consequence of their difference of volatility, by submitting the solution to sublimation, or from their difference of solubility, by evaporating to a certain degree,

or by exposing the dry mass to deliquescence, reduced to a solid state; or lastly, allowing them to crystallize, when the salts will fall to crystallize in a different form. This process may be repeated till complete.

## CCCLXI.

Simple salts are divided into two orders, of alkalies and acids.

## CCCLXII.

Alkalies are salts of a peculiar pungent taste, are caustic when pure, or corrode the skin, and dissolve animal matter. They change blue or red vegetable colours into green. They unite with acids, and both thereby lose their distinguishing qualities. They unite also with oils or animal fats, to form soaps. They dissolve earths, and attract water from the atmosphere.

## CCCLXIII.

Alkalies, from their origin, have been divided into three different kinds, as derived from the vegetable, fossil, and animal kingdoms.

## CCCLXIV.

*Vegetable Alkali.*

The vegetable alkali is a pungent salt procured from plants, particularly their woody parts burnt to ashes. Its appellation is derived from kali, the Ægyptian name of the plant first used to procure it. It is freed from the impurities of the ashes by solution, and evaporation repeatedly taking place; and it is then presented in a solid form, of a white colour.

## CCCLXV.

In this state it is highly caustic, powerfully attracts

humidity from the atmosphere, changes vegetable blue colours to a green, and is fusible at a moderate temperature, though it cannot be volatilized.

## CCCLXVI.

One of the chief and most useful properties of this alkali is its combination with oils, in the formation of soap; and to render it more caustic for this purpose, it is combined with lime. Thus, if one part of the oil be mixed with half its weight of a strong solution of pot-ash, a thick white mass is found diffusible in water, forming a milky like mixture. By boiling a more intimate union of this compound is formed, and a solid substance procured.

## CCCLXVII.

*Soap.*

Thus soap derives its solubility and detergency from the caustic alkali; and the oil is necessary, in order to moderate the sharpness and activity of the alkali, and to give a slipperiness to the clothes, otherwise it would injure the clothes, and it would be impossible to handle them with the caustic alkali adhering; and as one of the means of extracting the foul matter is mechanical violence, it would injure the clothes greatly, were they not rendered slippery, and the friction diminished. So in the process of bleaching, where the cloth is exposed to violent friction, it answers the purpose.

## CCCLXVIII.

Soap is also soluble in spirit of wine, and in a mixture of spirit of wine and water it is still more so than in either separately. Heat increases the dissolving powers of these

menstrua, and cold diminishes it; if too much is dissolved by heat, the superfluous concretes into threads, or a jelly, in proportion to the quantity; but this jelly has a sort of fibrous structure, and contains in its pores a quantity of liquid matter. Soap, dissolved in spirit of wine, has a disposition to concrete into fibres, and the spirit acts upon the soap in consequence of its attraction to the oil, as well as for the alkali. For when we decompose the soap, so as to have the oil pure, it will dissolve in the ardent spirits; it has undergone some change which gives it this quality. So we can readily separate the oil from the alkali, by means of acids, which immediately unites with the alkalies.

## CCCLXIX.

This effect of acids has led to the knowledge of the cause of hardness in waters, with respect to soap. The meaning of this term is, that such water renders the surface of the soap greasy, and requires the soap to be agitated long before it will form a lather with it; and when by long agitation we obtain a dissolution, the water throws up a greasy scum, consisting of the oil of a small part, decomposed by an acid in the water.

## CCCLXX.

Such waters are rarely found to contain a pure or separate acid; but combined with some substance that does not adhere so strongly, as the calcareous earth, the earth of magnesia, of alum, and in the several metals in which the acid is so little felted; yet it is ready to act as if it was pure: so it prevents the water from readily dissolving the soap, till by the fore-said dissolution of a small quantity the acid is neutralized; after

which it will dissolve the soap, as well as other pure water.

## CCCLXXI.

This quality of waters proves often very inconvenient, as there are many manufactures in which it is necessary to employ large quantities of soap, dissolved in water; so it is of great consequence to have water as soft as possible, to prevent a waste of soap, as in bleaching, &c. And therefore it is of consequence to learn how to discover hard water, and to find out a cure. Different methods have been proposed; but there is no occasion for many new chemical trials; the trial with soap is as accurate and nice a one as is necessary. Or dropping in a solution of fixed alkali, if there is any such compound, it renders the water muddy; but unless there be a certain quantity, the muddiness will not be observable, yet the water is hard with regard to the soap; so the trial with a bit of soap is sufficiently nice.

## CCCLXXII.

With regard to the cure, there is no doubt the addition of an alkaline salt will remove this bad quality; but it is plain that this remedy cannot be put in practice, at a moderate expence; and it is eligible to chuse a water, that is naturally soft. This method of softening water is employed on particular occasions, as in cookery; a small quantity of alkali added makes the water boil vegetable substances more quickly and more tender, and at the same time it preserves their colour in greater perfection.

## CCCLXXIII.

Besides the oils, this alkali forms various combinations with the other inflammables, as we shall afterwards find;

but it possesses no action on the simple gases. Its strongest attraction is for water, being the most deliquescent of the three alkalies, and it dissolves in a quantity of fluid equal to its own weight; but, at the same time, by evaporation, it can be reduced to a crystallized form; and from some facts, its analysis has been referred to be a combination of lime and hydrogen, though this is by no means established.

### CCCLXXIV.

#### *Fossil Alkali.*

Fossil alkali, or soda, possesses all the more general qualities of alkalies enumerated. It requires a strong heat to melt it, and evaporates when it is exposed to a strong heat. It dissolves in water without any impetuosity, and about one-sixth of its weight in water saturates it. It is easily separated by crystallization, affording crystals that are flattish, two planes uniting at their edges with two other planes, forming an oblique termination by their union; but it is difficult to get these quite perfect; most commonly one end, or the greatest part of one crystal, being entangled with another.

### CCCLXXV.

These crystals contain a great deal of water, in consequence of which they are liable to the watery fusion; but when the heat is suddenly applied, so that the water quickly evaporates, the salt cements in the form of a crust. In like manner they are liable to spontaneous calcination; but when kept in dry air, a part of the water is apt to evaporate, whereby the crystals lose their transparency.

## CCCLXXVI.

With regard to its origin, it is one of the salts which has been longest known and in use. It is mentioned under the name of nitre, in several parts of the Bible, as appears from the different qualities mentioned belonging to nitre, and which shew it to have been a sort quite different from that now known by the same name.

## CCCLXXVII.

It has also been got in considerable quantities in Africa, in the kingdom of Tripoli in Barbary, being brought from some of the mountains to the sea-coast, as a considerable article of commerce. Great quantities are sent to Constantinople. It is a natural production, and dug up from the bowels of the earth, by running among very large quantities of common salt. There are also mountains of it in the inland parts of Africa, and there are also veins found of this alkali. It is likewise found in Egypt, where it forms a kind of hoar-frost upon the surface of particular places, and where it is left by stagnating water, which had it dissolved. It is also found upon Teneriffe; but there are no examples of it in Europe, only upon the plaster of walls and cellars, and other damp places. We find a white downy efflorescence, which is found chiefly to consist of the fossil alkali, which is the only example of a natural production, except what is found in the waters of some mineral springs; and we have no such examples of it as found in Africa. Upon the whole, we rarely meet with it in its independent state, but it occurs in combination with other salts, and in this state it is found in immense quantities in the bowels of the earth, and in springs; also in the sea, so as it got the name of



fossil; and such a salt is obtained from the ashes of sea plants; the one for obtaining it of the best quality, is the kali, and from this plant all the alkalies have got their name. The ashes from sea-weeds are prepared upon the coast of the Mediterranean, under the name of soda; and upon our coasts they melt the ashes into an impure mass, called kelp, which is purified by those that use it.

## CCCLXXVIII.

In its pure state soda is a solid white mass; in its leading qualities it resembles the vegetable alkali, and they differ chiefly in their orders of attraction, as we shall afterwards find. From analysis, this salt has been supposed a combination of magnesia and hydrogen.

## CCCLXXIX.

*Volatile Alkali.*

The volatile alkali, or ammonia, differs from the two former more than they do from one another. It shews a great degree of volatility when exposed to a gentle heat; in the ordinary heat of the air, affording vapours which affect the nose. It is commonly known by the name of volatile salts. So salt of hartshorn when exposed to heat, totally evaporates long before it arrives at the heat necessary for its fusion; and if a cold body is exposed in the way of its steam, it forms a solid white saline crust upon the internal surface of the body. It does not seem acrid; for when applied to the skin, the heat makes it evaporate; but when it is confined by a plaster, it will quickly destroy that part to which it is applied. It dissolves easily in water, and sometimes crystallizes; but it cannot be separated by evaporation and

crystallization. It is so volatile that when heat is applied, it begins to evaporate first.

## CCCLXXX.

With regard to its origin, it is found no where in nature pure. Sometimes it is found in the air, hanging over animal and vegetable substances, produced by their putrefaction. By a burning and destructive heat applied to them, they produce vapours; and these vapours, when condensed, are found to contain a large quantity of this salt, with other matters which repress its volatility. Urine, putrified to a certain degree, is found to contain a considerable proportion of it; and hence the detergent quality of putrid urine. No animal substance affords it in greater quantity than the horny parts and bones. Formerly the horns of the hart were, for this purpose, principally used in pharmacy, and hence the salt still retains the name, though now the chemists have found that it is afforded, of the same quality, by other animal horns and bones; and they employ the animal bones of different kinds, out of which the oil has been previously extracted. There is also a compound salt, of which it constitutes the half, viz. sal ammoniac; and from this it can be prepared in a purer state than from any of the former substances, as thus obtained it is called sal ammoniacum volatile. In all these processes a quantity is commonly combined with the water, as in extracting it from animal substances by means of fire; and in the separation of it from urine it would require many repeated distillations to separate it entirely. Such a part as arises in a watery form has been called spirit by the chemists, which name they have given to most alkalies obtained by distillation;

hence the spirit of hartshorn, of urine, of sal ammoniac. These are all names for the same alkali, as combined with the water, and in different states of purity.

## CCCLXXXI.

Thus it is obtained from animal substances either by heat or putrefaction. The composition of ammonia is more certainly known than that of the other alkalies; and it is discovered, by its decomposition, to consist of a combination of hydrogen and azote, being formed by presenting the two gases to each other in their nascent state.

## CCCLXXXII.

The solution of these different alkalies in water is distinguished by different appellations, which are necessary to be known: the first, or vegetable, being named caustic lie; the second, or fossil, soap lie; and the third, or volatile, caustic volatile spirit.

## CCCLXXXIII.

*Acids.*

Acids, the opposite of alkalies, are salts of a sour taste, and always appear naturally in a fluid form. They change vegetable blue colours into red, act as caustics on animal matter, and have a strong attraction for water. With alkalies and alkaline earths, they effervesce and form compounds, on which the distinguishing qualities of each are lost, and a neutral salt formed.

## CCCLXXXIV.

The acids are more numerous than the alkalies, and they are divided like them into the fossil, vegetable, and

animal; of each of which, particularly of the second, there is a great variety.

## CCCLXXXV.

As alkalies are a composition of hydrogen and azote, so acids are entirely a composition of oxygen, with a particular base. This we formerly observed on that subject (CCXXII.); and according to the various proportion in which the oxygen is united with the base, the acids are distinguished, as there stated, by different terminations (CCXXV). From oxygen being so much absorbed by the combustion of inflammable and metallic bodies, acids are particularly formed by this process.

## CCCLXXXVI.

The fossil acids, being the most powerful, claim our attention first, and they are distinguished by the names of the sulphuric, nitrous, and muriatic. They are also distinguished by certain common qualities.

## CCCLXXXVII.

On account of the manner in which they are obtained, the only form we can have them in is that of a watery fluid, which is their strongest state. In this state they may be considered as volatile, when compared with the more fixed salts. The vitriolic does not endure a degree of heat that makes it red hot, and the other two are much much more volatile than it.

## CCCLXXXVIII.

They all agree in having a very strong attraction for water; they attract it from the air very quickly, and unite with water, with rapidity, violence, and the production of heat. Upon this account it has been thought

strange that they should produce cold, when mixed with ice; but this has been already explained, as depending upon the great quantity of heat absorbed by the ice, when liquified by the acid. As the nitrous acid produces the most intense cold, some have represented the vitriolic as incapable of producing cold in this way; but this arises from the improper way of making the experiment, their using too large a proportion of it for the first acid added, liquified the ice, and produces the cold; but after it is made liquid, by adding more acid, it will produce heat. So care must be taken not to add more of the acid to the ice or snow than is barely sufficient. And in like manner, with the other acids, though the vitriolic causes the greatest error, as it produces the greatest heat in mixing with the water. When it is diluted with a large quantity of water, we can in some measure separate it again by distillation; and by repeating the process of distillation, the acid is obtained in its strongest state; and this operation is called the rectification, dephlegmation, or concentration of acid; but the operation can only be carried to a certain length; for their attraction for water is so strong, that they cannot be had dry, therefore acids are always found, exhibited, and used in the form of fluids. They are to be considered as solid fluids dissolved in water, and appearing in a fluid form, in consequence of their combination with that fluid. This makes it difficult in them to shew any natural tendency to solidity; this tendency, however, is shewn on different occasions. The vitriolic, when strong, will become Glauber salts, a great part of it being formed into small fibrous crystals, so as to give the whole the form of ice.

## CCCLXXXIX.

In like manner, with regard to the nitrous acid, Fahrenheit, in producing a great degree of cold by the mixture of this acid with snow, at 40 below nought, found that some small phials of the pure acid were coagulated, and part of the salt was formed into crystals throughout the liquor; so we have experience of a tendency to solidity in these two acids.

## CCCXC.

With regard to the muriatic acid, no crystals have been observed to have been produced in it; but by exposing it to the same or a greater degree of cold, it might discover also the tendency to solidity.

At any rate, there is another way of taking the acids, which shews that they are at bottom of the same nature with other salts, by joining them with the fixed alkalies. With these they unite very strongly, their volatility is repressed, their attraction diminished, and we can separate the water from them by evaporation, and have them in a dry solid form, requiring a strong red heat for fusion, capable of being reduced to the form of crystals, and having all the other qualities as belonging to the salts in general.

## CCCXCI.

Another quality in common with the acids is, that like alkalies they change the same infusion, viz. the purple and blue colours of vegetable substances, but in a different manner; for if blue, they change it into a red; or if purple naturally, they brighten the red, and diminish or entirely abolish the blue. A very small quantity of the acid is sufficient to produce this change. This change of colour is shewn in the infusion of roses, the syrup

of violets, and in the infusion called litmus, or turnsoil, which is sold by those who deal in dying; and the effect produced by the three acids is exactly the same, though the different colours of vegetables are differently affected. In some the acid is stronger, and the blue more fully abolished; and the same effect is produced, though they have been previously tinged of a green colour by an alkali. In like manner, the alkali will change the colour alternately. If the alkali is added gradually to the syrup of violets, for instance, it first restores the natural blue colour; but if more is added, it changes it to a green.

## CCCXCII.

Another common quality of these acid is, that of uniting with the alkalies, and producing no effervescence; and it is therefore used as a criterion of the acid salts; for there is no other substance soluble in water that effervesces in the same manner, except the acids, and this is in like manner used as a criterion of alkaline salts; for there is no salt soluble in water that effervesces with acids, except the alkaline salts. These acids also effervesce with the metallic substances, and with the absorbent earths, as chalk, limestone, marble, &c.; and as they shew a peculiar dissolving power over earths and metals, they shew an acrimony and corrosive power over animal substances. If taken internally, they would destroy the places to which they are admitted; and when they are applied to the surface of the body, they produce a pain like a burning coal, and as quickly destroy the part.

## CCCXCIII.

These properties they shew in their strong state. When

diluted with water, to a certain degree, they have not these powers; they lose entirely that excessive acrimony, and their most general effect is to prevent or retard fermentation or putrefaction, and they are taken as medicines. They are cooling and astringent, and impress a particular taste upon the tongue, which their name imports.

## CCCXCIV.

*Sulphuric, Sulphurous, or Vitriolic Acid.*

In entering upon the acids, as formerly observed, they are presented always in two states, as containing a greater or less proportion of oxygen, which states are distinguished by their different terminations of *ous* and *ous*.

The name of this acid is derived from vitriol or copperas, from which it was formerly prepared, and in which state it is combined with iron; but is now most commonly procured from the combustion of sulphur. When pure it is colourless and transparent, of great weight, almost of double that of water; at the same time, it has somewhat the appearance of less mobility or fluidity than water; and having some degree of the sluggishness or lenor of oil, it is called oil of vitriol. The salt it contains is more fixed than water, so that it endures the heat of the air, and even a more violent heat, without our perceiving any effluvia proceeding from it, or its giving the least perceptible smell. It has such a powerful attraction for water, that the heat which is produced by their union is supposed to be occasioned by it; but perhaps it is more probably owing to the contraction of the volume which takes place, being remarkably strong in this mixture. The heat is so strong, that if the union is made in a glass vessel not fitted for bearing such sudden alterations of heat



and cold, it will be broken. The most convenient is a Florentine flask. So great is its effect, that if water is applied to the outside of the vessel, it is thrown off in steams; and if the water is warm, there is a stronger agitation or commotion of the mixture, the addition of heat communicated by the acid, converting a part of the mixture into steam, by which means it is thrown out of the vessel.

## CCCXCV.

It is now employed in the process of bleaching linen; and some of the manufacturers have complained of the danger of its falling in small drops upon the linen, which eat out into small holes; but it has been found that they followed the practice of mixing it with hot water instead of cold; and by the sudden explosion and ebullition of it, small drops of it were thrown about and scattered, so as to fall upon the linen. There is no advantage in using hot water, neither is there any difficulty in mixing it with the cold, so as to give the water the pretty sharp acidity wanted. It would indeed be a long time before the equal diffusion took place, if it were not agitated, from its falling to the bottom, on account of its great weight. If once equally dispersed, it will never separate again.

## CCCXLVI.

The attraction of this acid for water appears from the quickness and readiness, with which it unites it from the air, any quantity exposed to the air, attracting one-third of its weight in a day; and when long exposed, it will attract five times its weight, which is about 12 times its bulk. But the quantity attracted every day becomes less and less, having the greater attraction for water, the less it contains already, as is the case with the other salts.

## CCCXCVII.

In rectifying this acid, it is necessary to manage the operation in close vessels, though it is more fixed than the water, otherwise a great part of the acid will be lost. The retort and receiver are therefore used. The first vapour is nearly a pure water, and does not require much more heat than boiling water; but the remainder is much more strongly retained by the acid, and a more violent heat is required to continue the distillation. At length the heat rises to 600 of Fahrenheit, when the vapour arising contains as much acid as the liquor that remains in the retort, and then it is needless to continue the operation any longer. This operation is performed to prepare it for the market. For reducing it to a certain specific gravity, the watery part that comes first over, is put into the retort again, and the distillation repeated, whereby the acid is all recovered.

## CCCXCVIII.

This acid is most remarkable for its action upon the inflammable substances, in consequence of the attraction of the latter for its oxygen; thus, if a little of it be put into a glass, and some olive oil poured thereupon, the colour is generally darkened, a sensible degree of heat is produced, and sometimes streams arise from the mixture. The oil becomes very thick by the action of the acid, constituting a compound that has very near the consistence of tar, and is of a colour that resembles it, being at the same time very pungent. Suffocating vapours are emitted from it; but the oil that is used is not one of those that contains the principle of inflammability, in its most loose and separate state.

If one of that kind is taken, as the oil of turpentine, the action of the acid is violent, this oil being more inflammable than the other, and containing the principle of inflammability in a more loose state. There is generally a very violent heat produced, a part of the acid and oil are suddenly changed into vapour, which burst out of the vial, the mixture is of a black colour and considerable thickness, and the oil has acquired a particular smell, different from what it has in its natural state. This acid gives the same colour to all bodies, tinging even all bodies of a black colour. So when it is kept in a negligent manner, and any animal or vegetable substance touched with it, it acquires that colour; but this colour is easily removed by boiling, its own activity and acrimony, destroying the small quantity of matter that is mixed with it.

The proportion of the sulphuric acid, is 3.68 of oxygen, and 63.2 of sulphur.

## CCCC.

*Nitric Acid.*

Next to the sulphuric or vitriolic is the nitric and nitrous acid. This acid, when strong, is of an orange or yellow colour, and is constantly disposed to emit fumes, which is its proper form; its fluid appearance depending on its combination with a certain quantity of water. It is more volatile than the vitriolic, and of course we are less capable of concentrating it. It possesses, like the vitriolic, a strong tendency to unite with the inflammable principle of bodies, and in uniting with them it does it with violence and rapidity.

## CCCCI.

The origin of this acid is rather obscure, and it is only presented to us in those situations where the process of putrefaction takes place, though the manner in which it is here produced we cannot account for. At present it is extracted in greatest quantity from the compound salt, saltpetre, by adding to it a certain quantity of diluted vitriolic acid, and distilling them, when the nitrous acid rises in the form of elastic vapour; mixed with the vitriolic, and by adding to it a fresh quantity of nitre, and resuming the distillation, the nitrous acid is obtained pure; and by farther exposure to heat, from the nitrous it is converted into the nitric.

## CCCCII.

In combining with water this acid produces heat; poured on snow or ice it melts, and produces intense cold. Its composition is a combination of oxygen and azote, and its proportions are 72.2 of oxygen to 72.8 of azote in the nitric, and in the nitrous 70.1 of oxygen to 29.9 of azote.

## CCCCIII.

*Muriatic Acid.*

The last of the fossil acids is the muriatic, which possesses a pale colour, and in its pure state emits fumes like the nitrous, though these have no effect in tinging the glass, and its odour is equally corrosive with the former. It differs from the two other acids in having little attraction for the principle of inflammability, and on mixing with water, it loses entirely its caustic state.

## CCCCIV.

This acid is found, in small quantity, diffused in the atmosphere; but its most common source is from sea salt.

with which it is combined, and from which it is obtained, by mixing it with the oil of vitriol, and submitting them to distillation.

## CCCCV.

The composition of this acid has been supposed a combination of hydrogen, azote, and oxygen, but it is not confirmed by decisive experiments.

## CCCVI.

*Oxygenated Muriatic Acid.*

As the muriatic acid is capable of combining with oxygen, a compound is formed, by which its acid powers are lessened, termed the oxygenated muriatic acid. This acid peculiarly whitens vegetable colours, and differs in its attractions from the others. It is procured from the distillation of the black oxyd of manganese with the acid.

## CCCVII.

These acids, in their diluted state, have received different appellations; the first, or vitriolic, being named oil of vitriol; the second, or nitrous, aquafortis; and the third, or muriatic, spirit of salt.

## CCCVIII.

The fossil acids differ from all the others in their activity, and are always procured in the purest state; and by this they are distinguished from the rest, though they agree in their more general properties.

## CCCCIX.

*Boracic Acid.*

The boracic is an undecomposed acid. It does not exist in great quantity. It is chiefly found in combination with soda, and from this salt it is obtained, by adding to

its solution a proportion of sulphuric acid, till it acquires an acid taste. On cooling, white scales are deposited, which are freed, by washing, from any sulphuric acid, and are again crystallized. It is likewise procured by sublimation.

## CCCCX.

This acid is in the form of white scales, soft and somewhat unctuous to the touch. It possesses a saline cool taste, somewhat bitterish, with a slight degree of sourness. It reddens the vegetable blue colours, is soluble in twenty parts of cold, and five of boiling water. It is dissolved easily in alcohol, the solution being of a beautiful green, and burning with a green flame. By its fixity in fire, it is greatly distinguished from the other mineral acids.

## CCCCXI.

*Fluoric Acid.*

This acid is also one of those possessing an undecomposed base, and is procured from the fossil named fluor spar. It is obtained by adding one part of sulphuric acid to an equal weight of coarsely powdered fluor spar, and then applying a moderate heat. The acid comes over in the form of gas, as formerly noticed, and is absorbed by water, in which state it retains the acid properties. Its distinguishing quality is its power of dissolving siliceous earth, which resists the action of every other acid. This earth it dissolves very rapidly, and holds in a state of combination. In smell and taste, it resembles the muriatic acid.

## CCCCXII.

After the fossil, we enter upon the vegetable acids, of which modern chemistry has greatly increased the number, by our improved knowledge of the acidifiable

bases, from our greater powers of decomposition. This basis, in all the vegetable acids, is of a compound nature, being a proportion of carbon and hydrogen. The varieties in their properties depend on the different proportions of these principles, and of oxygen in each of them. These acids admit a division into three kinds, as ready formed, as obtained by the use of the nitric acid, or by the action of fire.

## CCCCXIII.

*Citric Acid.*

Of the first division, the citric acid is a principal one. It is found particularly in the lemon, the tamarind, and several other sour fruits, being obtained by expression. It is freed from its mucilaginous matter in several ways, as first, by precipitating it by alcohol; or secondly, by squeezing the juice of lemons, while the acid remains liquid, and in a concentrated state; or thirdly, by straining the juice through a linen cloth, then mixing it with spirit of wine; and after standing some days, it may be filtered through paper, when it will be found pure. Or what is a more common practice, by saturating the juice with powdered chalk, then separating the chalk by the addition of half its weight of sulphuric acid to the compound, diluted with six pints of water, when by evaporation of the filtered solution, the pure acid will be obtained.

## CCCCXIV.

Citric acid is decomposed by heat, and its products are carbonated hydrogen, carbonic acid, and an empyreumatic acid, with charcoal. When farther oxygenated, it is convertible into two acids, the carbonic and acetic.

## CCCCXV.

*Malic Acid*

Malic acid, the next in order, is chiefly procured from unripe apples. It is obtained pure by saturating the juice with chalk, and decomposing the compound by sulphuric acid, when the filtered solution is to be evaporated to a certain degree, for no crystals are formed.

## CCCCXVI.

It is decomposed, like the former, by heat, and yields more of the carbonic acid. It is likewise convertible by the nitric into the oxalic acid.

## CCCCXVII.

*Oxalic Acid.*

Oxalic acid, the third species, is chiefly found in the different kinds of tourel. The express juice, freed from impurities, deposits the acidulous oxalate of potash; and when freed from the latter, the acid has a penetrating sour taste, effervesces in the air, is soluble in half its weight of hot water, and twice its weight of cold.

## CCCCXVIII.

This acid, exposed to heat, is resolved into an acid liquor, carbonic acid, and carbonated hydrogen. It contains more oxygen than the other vegetable acids.

## CCCCXIX.

*Tartarous Acid.*

Tartarous acid, as it exists in vegetables, is combined with potash; and under the name of tartar, is contained in the tamarind, vine, and other fruits, being chiefly deposited during the slow fermentation of wine in casks. It is purified by solution, filtration, and repeated crystal-



lization. It has a sour taste, and requires for its solution 60 parts of cold, and 30 of boiling water. By exposure to heat, it becomes decomposed. Its pure acid is procured by the addition of sulphuric acid to the solution of the salt. Its products, by exposure to a high temperature, are carbonated hydrogen and carbonic acid, an acid similar to the acetous, and an empyreumatic oil, charcoal remaining.

### CCCCXX.

#### *Benzoe Acid.*

This acid exists chiefly in the balsams, and more particularly in benzoin, being extracted from it by the application of a moderate heat. The acid volatilized, condenses in white crystals. This acid exists also in the urine of graminivorous animals. But it is more commonly procured by boiling four parts of benzoin, with one of lime, and four of water, stirring them together over a gentle fire, for half an hour, by which the acid uniting with the lime, benzoate of lime is formed. After settling, the clear liquor is poured off, and the process twice repeated, with fresh lime water. The liquor should be then filtered, and muriatic acid added, as long as any precipitate, which is the acid of benzoin, falls. It is then to be dissolved, filtered, and gently evaporated. It is procured by sublimation, in the form of flowers of benzoin. It possesses a slight pungent taste and grateful odour; in which it differs from the other acids by retaining an essential oil. It is chiefly soluble in hot water, and the solution crystallizes in cooling. It is soluble also in alcohol, and is volatilized by a moderate heat. It burns when strongly heated in contact with air. It possesses a strong attraction for lime.

## CCCCXXI.

*Gallic Acid.*

This acid is yielded by many barks, roots, and fruits, and is in all those vegetables termed astringent; but it is most commonly obtained by an infusion of powdered nut-galls, in the proportion of one lib. of powder, to two pints three quarters of water. This infusion, after standing four days, and frequently shaking the mixture, is then filtered, and kept in a vessel covered with blotting paper. A thick pellicle of mouldiness then forms on the liquor, and a precipitate descends in proportion as the infusion evaporates. This precipitate, dissolved in water, forms a liquor of a brown yellow colour, which in evaporation deposits the acid in a precipitate, like fine sand, and crystals of a yellow hue.

## CCCCXXII.

This acid has a sour, astringent taste, effervescing with chalk, and reddening turnsole. It is soluble in three parts of hot or 12 parts of cold water. By heat it becomes volatilized, and partly decomposed; from which it appears to consist of an empyreumatic oil, carbonated hydrogen, and carbonic acid. Hydrogen and carbon, therefore, form its base.

## CCCCXXIII.

The peculiar distinction of this acid is that of producing a deep black colour with the salts of iron, when the metal is in a certain degree of oxydation; but it is only the red oxyd that succeeds in the making of ink. Thus the combination of iron with the gallic acid is the basis of ink and black dyes.

## CCCCXXIV.

*Tannin*

Connected with the gallic acid, is the tannin or tanning principle. Their properties are however different, and they can be obtained distinct, though they exist always in the same substances. To obtain this principle in the pure state, to an infusion of oak bark in hot water, a solution of muriat of tin is added. Thus an insoluble compound of tannin with oxyd of tin is formed. If a current of sulphurated hydrogen is passed through the liquor, it combines with the oxyd of tin, and the tannin is left dissolved. This solution is of a brown colour, and has a bitter styptic taste, and by evaporation it may be obtained in a solid mass.

## CCCCXXV.

It communicates to iron the same dark colour as the gallic acid, but its peculiar property is to combine with animal gelatine, on which the art of tanning depends, and to prevent the decay of those parts with which it is combined.

## CCCCXXVI.

*Camphoric Acid.*

The next division of vegetable acids is those obtained by the mediation of the nitric acid. The first of this division is the camphoric acid, which is obtained by the decomposition of camphor. When pure it has little or no odour; its taste is slightly acid, and it reddens the vegetable colours. It is very volatile, it is distinguished from the benzoic acid, which it much resembles by its greater solubility in cold water. It burns without any residuum.

## CCCCXXVII.

*Suberic Acid.*

The suberic acid is obtained, as its name imports, by distilling nitric acid from cork. The residuum is exposed to a moderate heat, till pungent, suffocating vapours arise. To this thrice its weight of water is added, and heat applied. The solution of suberic acid then obtained, is separated by filtration, when cold. It may be also obtained by evaporation, in a solid form. It is volatilized by heat, is soluble in water, possesses an acid bitterish taste, and becomes brown by exposure to solar light. It differs from the former acid both in its precipitation and form.

## CCCCXXVIII.

*Succinic Acid.*

The succinic acid is obtained by exposing amber to a moderate heat, an empyreumatic oil, with an acid liquor, distils over, and a matter concretes in crystalline plates, in the neck of the retort. This matter is the succinic acid, which may be purified by a second sublimation, or by solution and crystallization. It is likewise procured by distilling weak nitric acid with half its weight of salt of amber, the nitrous gas coming over, and leaving the acid behind.

## CCCCXXIX.

The taste of this acid is acrid ; it is soluble in 24 parts of cold and in two of boiling water, the latter crystallizing on cooling. Its crystals are permanent in the air, and are volatilized by heat.

## CCCCXXX.

The third division of vegetable acids are those obtained by the action of fire ; of these are,

1. The pyro tartarite acid, yielded by the tartarous acid by dry distillation.

2. The pyro mucilaginous acid, obtained from insipid, saccharine, gummy, or farinaceous mucilages; and this acid has a peculiar property of reddening the skin.

3. The acetic and acetous acid, or vinegar, is produced chiefly, as we shall afterwards find, by the process of fermentation. It is clear and nearly limpid; it has a pleasant pungent smell, and a sour taste.

#### CCCCXXXI.

The acetous acid, or vinegar, is like the other acids a watery fluid, and unavoidably diluted with a large quantity of water. In point of strength, it is hardly equal to a mixture of the fossil acids, with above 50 times their weight of water. There is mixed with it some slimy and mucilaginous matter, and also some of the tartarous acid, from the wine. This acid may be purified by distillation, the pure acid being more volatile, and rising in a heat little more than that of boiling water. This is accordingly often performed, and the product is called distilled vinegar, which turns out limpid and colourless, like water; the unctuous and mucilaginous matter, when the operation is carried to a certain degree, is found in the retort, forming a black matter; which, if the operation is carried farther, affords other matters that give a disagreeable odour to all the steams that arise. It is necessary only to distil this acid, which makes it resemble the fossil acids, and fits it for the common uses to which it is applied in pharmacy. It has the same sour taste with them, when they are diluted to a certain degree. It effervesces too with the alkaline salts, in the same

manner. It also affects the colour of vegetables in the same manner; thus the infusion of roses has its colour brightened, but the change is not so quick and remarkable as when the fossil acids are used; neither is it equal in its corrosive qualities, even when of the same degree of strength. Another remarkable particular by which it differs, is in its being totally changed and destroyed by heat, when it is so strong as to make bodies red hot.

The acetic, or radical vinegar, is procured by saturating the vinegar with a metallic oxyd, and again decomposing the compound by heat.

#### CCCCXXXII.

The animal acids, the third division, are not so numerous as the vegetable, and the first we shall notice are those existing in, or derived from the human body, as the lactic, sebacic, zoonic, uric, and phosphoric acids; the others are peculiar to certain animals.

#### CCCCXXXIII.

The lactic acid is obtained by subjecting milk to the acetous fermentation; but this fermentation differs from that of vegetables, both in the manner in which it takes place, and also in the production of the operation, being a different acid. To procure this acid pure, the sour milk should be evaporated to  $\frac{1}{3}$ , the extraneous or cheesy matter separated by filter, and lime water poured on the residue. By this a precipitation takes place, and the lime combines with the acid. To decompose it oxalic acid next is to be added, which precipitating the lime, leaves the acid disengaged. This liquid must then be evaporated to the consistence of honey; and if alcohol is added the acid will be taken up, and all the other principles

remain undissolved. On filtering the mass, the pure acid will be procured by distillation.

#### CCCCXXXIV.

From the sugar of milk is obtained also the saccho lactic acid, when heated with nitric acid, with the assistance of a moderate heat.

The base of these acids is considered to be a compound of hydrogen, carbon, and azote.

#### CCCCXXXV.

##### *Sebacic Acid.*

This acid is procured from the fat of animals by distillation. When pure it is fluid and colourless, has a pungent odour, and a sharp acid taste. It is soluble in water, in all proportions, and is naturally formed in the fat, when exposed to the air, by its absorption of oxygen. It is decomposed by heat, carbonic acid being disengaged, and charcoal remaining.

#### CCCCXXXVI.

##### *Zoonic Acid.*

The fluid obtained from the distillation of animal substances has been found to contain a peculiar acid. In order to procure it the oil is first separated from the liquor afforded, by destructive distillation; then lime added, to separate the carbonate of ammoniac with a boiling heat; and afterwards more lime is added, to obtain the zoonate of lime. By distilling a mixture of phosphoric acid with this preparation, the pure zoonic acid is procured.

#### CCCCXXXVII.

This acid has the smell of roast meat, in which process

it is formed. It is of an austere taste, and shews the tests of an acid with turnsole.

## CCCCXXXVIII.

*Uric Acid.*

This concreté acid of calculi is slightly soluble in boiling water. It forms the chief part of the red coloured precipitate which urine deposits. It is therefore to be found in all urine, but only by its undue retention, or circumstances occasioning its formation in excess, does it become the source of disease.

## CCCCXXXIX.

From a variety of experiments, it appears that the base of this acid is a peculiar animal oxide, and that its presence is confined to the human body; that the same base is conspicuous in the concretions of the gout, being formed of this acid and soda.

## CCCCXL.

In the examination of different calculi, a great variety is found to prevail in the proportion, and even in the nature of their constituent principles; but this peculiar substance or base is always present in a certain degree in all of them.

## CCCCXLI.

By different trials it appears, that the calculus is dissolved by the sulphuric acid with heat, is not acted on by the muriatic acid, is dissolved by the nitric acid with effervescence, and the disengagement of the nitrous gas and carbonic acid, the solution being of a red colour, and containing a disengaged acid. Next, the calculus is not



acted on by the carbonate of potash, but is dissolved by the caustic as well as the volatile alkali. It is also dissolved in lime water, and may be precipitated by acids.

#### CCCCXLII.

The uric acid is insoluble in cold water. It weakly reddens turnsole; it is insipid and inodorous. When pure it has a fawn colour, and by the addition of nitric acid it acquires a pink.

#### CCCCXLIII.

##### *Phosphoric Acid.*

The phosphoric acid is obtained by the combination of oxygen with the phosphorus, during combustion. It is very deliquescent, and soluble in water. Its saturated solution is of an oily consistence. It is inodorous, and possesses no volatility, neither is it decomposed by heat. It consists of 100 parts of phosphorus united to 154 of oxygen.

#### CCCCXLIV.

These form the principal acids that are met with in the human body; those that are met with in other animals are chiefly the bombic and formic.

#### CCCCXLV.

##### *Bombic Acid.*

This acid is derived from the silk worm, and is contained in a cell near the anus. It is in a liquid form, and of an amber yellow colour. It is liable to spontaneous decomposition. It is obtained by squeezing the juice of the chrysalis through a cloth, precipitating the mucilage with alcohol, and also by infusing the chrysalis in alcohol.

## CCCCXLVI.

*Formic Acid.*

This acid exists in the ant, in a very disengaged state. It is evolved in a strongly odorate vapour, and its smell resembles that of musk. It is procured chiefly from the large red ant, and is most abundant in the months of June and July, so that the passage of the animal over blue paper detects at once its presence, by reddening it. The acid may be procured by distillation, mixed with empyreumatic oil, from which it may be separated by a funnel; or it may be procured by lixiviation, first washing the animal in cold and then in boiling water, till all the acid is extracted.

## CCCCXLVII.

*Prussic Acid.*

The only remaining animal acid is the prussic, obtained by exposing horns, hoofs, or dried blood, with an equal quantity of fixed alkali, to a red heat. The alkali united with the acid thus formed, is called prussiate of potash, or soda. The prussic acid is obtained in a pure state by super-saturating the prussiate alkali with sulphuric acid, and by subsequent distillation. It may be also obtained by distillation of blood with nitric acid. It has a sour taste and suffocating smell.

## CCCCXLVIII.

We have thus examined, in a general way, the several species of simple saline bodies, under the two divisions of alkalies and acids. We shall next consider their particular action on one substance of the inflammable class, alcohol, as giving origin to some powerful preparations

in medicine. The vegetable alkali acts on spirit of wine, by attracting water from it. If much alkali be used, a small part of it dissolves, and gives it a yellow colour and disagreeable taste; and if the spirit is allowed to retain the alkali, it is found to be a more powerful solvent. So the chemists have studied the way of making tartarised spirit of wine, and Dr. Boerhaave considers the making of it right, as a nice and difficult operation. We first use a spirit as strong as possible, and we are to have the salt of tartar well calcined, and put in perfectly dry and hot; for if either the spirit has water, or the salts get water from the air, it will not succeed. But a perfect caustic alkali dissolves perfectly and uniformly, and that in the strongest spirit, and soon after it is dissolved it communicates to it a very deep yellow or red colour, especially if it is digested a little.

## CCCCXLIX.

This explains the nature of tartarised spirit of wine, and points out a process by which it can be very easily prepared. That prepared by Boerhaave is only a spirit which has dissolved the most caustic part of the common fixed alkali. But taking the alkali entirely caustic, we can dissolve almost as much as we please; and this acting upon the oil, gives it this deep colour, which is a proof of the richness of the alkalised spirit.

## CCCCCL.

As the effects produced by an alkali that is perfectly caustic, upon spirit of wine, are different from that produced by the alkali, in its ordinary state of causticity, so if we take one saturated with air, it is so much neu-

trallized by the air that it has much less attraction for water, and we find that the spirit of wine is capable of separating it.

## CCCCLI.

The relation of the volatile alkali to spirit of wine is somewhat similar to that of the fixed, in its milder state, it will not mix with the spirit of wine, but is precipitated. But the experiment with the volatile alkali, most taken notice of, is the sudden precipitation of this salt from water, by means of spirit of wine, forming the *ossa helmontii*. Boerhaave describes it as difficult to be executed, on account of the great strength of the spirit that was necessary. To a quantity of the spirit of sal ammoniac we add an equal bulk of strong spirit of wine; it is poured in slowly, to float on the surface of the alkaline spirit, and they will remain perfectly fluid. But if they are suddenly shaken, the mixture becomes muddy, and in some cases perfectly solid. This Boerhaave admires, as an example of the production of a very subtle soap. He was an admirer of all saponaceous mixtures, and thought that this was one of the most curious of any, and one of the most subtle and penetrating of any of the mixtures, as containing the most subtle fluid of the inflammable substances, combined with the most volatile and subtle of the alkalies; but it has only the appearance of solidity. By the most copious and sudden precipitation of the volatile alkali, the spirit of wine uniting with the water, disposes the alkali to separate in crystallizations, which are very small, and the fluid that remains is entangled in the pores, as water in a sponge, the spirit does at the same time unite with the caustic part, but it can

be united more perfectly with the caustic volatile alkali, merely by mixing them together.

## CCCCII.

The action of alcohol on acids is peculiar and important. The alcohol becomes decomposed, and a new compound is formed. This differs somewhat in its properties, according to the particular acid used; but all the new compounds thus formed agree in the possession of certain general qualities. They are highly volatile, odorous, pungent, and inflammable, miscible in water, and capable of combining with alcohol. These compounds are known by the name of ethers.

## CCCCIII.

*Sulphuric Ether.*

To prepare sulphuric ether, any quantity of sulphuric acid is poured upon an equal quantity of alcohol in a retort. They are to be mixed together by gradual agitation, after which heat is applied by a sand bath, and the retort is connected with a range of receivers kept cool by water. On the boiling of the liquor, which takes place at 208, a colourless fluid condenses in the receivers. As soon as the neck of the retort becomes obscured with white fumes, which is generally when the distillation amounts to one half of the liquor employed, the process should be stopped, and in the retort there will be found remaining a thick black fluid. The distilled liquor is to be then purified with a small proportion of potash, and subjected to distillation, when it is obtained by the second operation nearly pure.

## CCCCIV.

The theory of the formation of ether is still undecided.

It appears however that the acid resigns its oxygen to the alcohol; that part of the hydrogen of the alcohol is spent in the formation of water, and a large portion of carbon is deposited, while the remaining principles combine to form the ether. Hence the compound differs chiefly from alcohol, in its greater proportion of hydrogen; and hence from its combustion more water is produced than from alcohol.

## CCCCLV.

Towards the termination of the process for ether, an oily matter comes over, which is named sweet oil of wine. This differs from the ether itself, in containing a larger proportion of carbon, and is consequently heavier and less volatile than the ether,

## CCCCLVI.

Such is the process for the sulphuric ether, and the other ethers differ from it in some circumstances.

## CCCCLVII.

*Nitric Ether.*

The nitric ether is a preparation much more difficult than the former, from the violent action of the acid on the alcohol, when they are mixed together in due proportion. The acid is therefore to be cautiously added, and in small quantities at a time, till an equal proportion is united. In the process, the nitric ether partly distils over, and partly remains in the retort, on the surface of the remaining acid liquor. It is to be poured off, and purified by a second distillation, with a gentle heat.

## CCCCLVIII.

In the common preparation of the dulcified spirit of

nitre, the proportion of acid to obtain it is one part to three of alcohol, which are allowed to digest in a gentle heat. Thus ether is alcohol with nitric acid, partly in an uncombined state; and to remove this, a second distillation, with a small quantity of alkali, will be sufficient.

## CCCCCLIX.

The theory of nitric ether is still more obscure than that of the sulphuric. It appears that part of the carbon, hydrogen, and oxygen, enters into new combinations, and compose the acetous and oxalic acids, which are formed, and that the remainder of these principles combine with part of the acid to form the ether.

## CCCCCLX.

No ether is formed with the muriatic acid and alcohol, but it takes place with the oxygenated acid. Acetous and phosphoric ether can likewise be obtained by distilling these acids with alcohol; and adding oxyd of manganese to furnish oxygen.

## CCCCCLXI.

*Compound Salts.*

We have thus described what are termed the simple salts, consisting of the alkalies and acids; we are now to view them in combination, under the title of compound salts, when they lose the peculiar properties they possessed in their more simple and separate state.

## CCCCCLXII.

Every compound salt is formed of an alkali and an acid, either united spontaneously, as they are found at times in nature, or combined by art; and from the different kinds and species of alkalies and acids employed, the

different compound salts arise, commonly termed neutral salts, and the criterion in forming each of them, or of its having acquired this neutral state, is not to be taken from the ceasing of its effervescence, but from its effect in changing the vegetable colours, mentioned in the definition of the simple ones, and when it can be depended on from the taste.

## CCCCCLXIII.

In forming this combination, the two ingredients can only be mixed in a certain steady proportion; and any addition beyond this, is not united, but remains in the same state as before it was added. The amount of this proportion in which they can be added, is termed the point of saturation, and the salt brought to this state is a neutral.

## CCCCCLXIV.

A neutral salt, compared with its original ingredients, is to be considered as a mild substance; it shews much less activity and acrimony with regard to a variety of substances; it has less attraction for water; it is not deliquescent; it may be taken internally, in a considerable quantity; and it has no peculiar effect on vegetable colours.

## CCCCCLXV.

In designating neutral salts, the state of their acid in entering into combination, claims particular notice. When completely saturated with oxygen, they receive the termination of *ate*. When the acid is only in limited proportion, they are marked by the termination of *ite*.

## CCCCCLXVI.

In arranging neutral salts, we are directed by the order



in which the acids were detailed. The compounds with the fossil acids come first, beginning with those formed by the sulphuric, termed sulphates.

## CCCCCLXVII.

*Sulphates.*

Sulphat of potash possesses a bitter penetrating taste, and is soluble in 16 parts of cold water; 100 grains of it containing 40 of acid, more than 52 of alkali, and eight of water.

Acidulous sulphat of potash is the same salt supersaturated with its own acid. It has a sour taste, reddens the vegetable colours, and is more soluble in water than the neutral salts.

Sulphat of soda has a very bitter taste, is soluble in its own weight of boiling water, and in three parts of cold; 100 grains of it contain 27 of acid, 15 of alkali, and eight of water. It is found in various mineral waters.

Acidulous sulphat of soda is formed when the former preparation is saturated with its own acid.

Sulphat of ammoniac is obtained from the soot of wood or coal. It is found also in the neighbourhood of volcanoes, and it may be prepared by the direct combination of its principles. In its taste it is very bitter. In 100 grains it contains 42 of acid, 40 of alkali, and 18 of water. It is soluble in twice its weight of water, in a mean temperature, and in an equal weight of boiling water.

## CCCCCLXVIII.

As the salts formed by the sulphuric acid are termed sulphates, so these formed with the same acid in a different state, or the sulphureous, are termed sulphites. Their

taste is sulphureous; they are decomposed by the greater number of acids; and by exposure to the air, or to substances affording them oxygen, they are changed into neutrals of the former class—Thus:

The sulphite of potash differs from the sulphate, in its proportions being more soluble in water:

The sulphite of soda contains 18.8 parts of soda, 31.2 of acid, and 50 of water; and

The sulphite of ammonia contains 29 of ammonia, 40 of acid, and 11 of water. From these proportions their difference from the former class is apparent.

### CCCCLXIX.

#### *Sulphurets.*

Besides those neutral salts formed with the acid, it is proper to notice here the compounds which sulphur forms with the alkali, termed sulphurets.

The first of these is the sulphuret of potash, obtained by fusing equal parts of sulphur and potash. It is of a red colour and inodorous, while in a solid state; but it soon imbibes moisture from the atmosphere, when it emits an odour resembling that of putrid eggs. The same effect follows its solution in water. By exposure to the air it loses its colour; and when the solution is examined, it is changed into sulphat of potash. This depends on the absorption of the oxygen of the air by the hydrogen of the solution, and the consequent oxygenation of the sulphur.

### CCCCLXX.

From this circumstance it has been employed as a eudiometer, but is inconvenient, as we formerly observed, from the slowness of its operation. To obviate which,

and render the absorption of oxygen more rapid, the use of the solid sulphuret, slightly moistened, with the application of heat, has been preferred.

This sulphuret is decomposed by acids, and the sulphur precipitating in the solution makes it to be termed, from its appearance, *lac sulphuris*.

### CCCCCLXXI.

Sulphuret of soda differs in nothing from the sulphuret of potash.

Sulphuret of ammoniac is obtained in the form of a yellow fuming liquor, by the ammoniac and sulphur uniting in the state of gas during distillation, from one part of sulphur, two of ammoniac, and six of quicklime. It may be absorbed by water placed in the receivers. A red coloured liquor is thus formed, which has a fetid smell, and emits copious fumes. It is decomposed in the same manner as the other sulphurets; but there is danger if the sulphuric acid is employed.

### CCCCCLXXII.

#### *Nitrates.*

These are a class of neutral salts, formed by the combination of nitric acid with certain alkaline bases. The attraction of the acid to these alkalis is strongest to potash, and least to ammonia. This class is distinguished chiefly by its cool penetrating taste, and by affording oxygen, on exposure to heat.

### CCCCCLXXIII.

The first, nitrate of potash or saltpetre, is a substance well known. It is produced by nature in abundance in warm climates, while in cold its formation is assisted by

**art.** Corrupted animal or vegetable matter, mixed with carbonate of lime, and exposed to the air, but protected from rain, after some months afford the compound salts, which consist of nitric acid, with potash and with lime. To their solution an addition of potash decomposes the lime, and the nitrat of potash is obtained, which requires to be afterwards purified.

## CCCCCLXXIV.

Nitrat of potash yields a pungent taste, and impresses the sensation of coldness on the tongue. It is soluble in seven parts of cold, and in one of hot, water. Its proportions are, in 100 grains, 44 parts of nitric acid, 51.8 of potash, and 4.2 of water.

## CCCCCLXXV.

The distinguishing property of this body is its deflagration or vivid combustion with inflammable substances, by yielding its oxygen; and on this quality of it the formation of gunpowder depends. This preparation is a composition of nitrat of potash, charcoal, and sulphur. Into this mixture the introduction of an ignited particle excites a vivid combustion, rapidly propagated through the whole mass, by which large quantities of the azotic, carbonic, and sulphureous gases, with water, are extricated; and in consequence of their high temperature, possess much elasticity and expansile force. The proportions of this composition in gunpowder, are 75 parts of nitre, 16 of charcoal, and 10 of sulphur; and by the last ingredient it is rendered more readily ignited. A still more powerful preparation than gunpowder is the pulvis fulminaris, consisting of nitrat of potash, carbonate of potash, and sulphur. By the mere application of heat

it detonates with violence, in consequence of the rapid production of sulphurated hydrogen.

#### CCCCCLXXVI.

Nitrat of soda is formed artificially, by the combination of its principles. It has a cool, bitter taste. It slightly attracts the humidity of the atmosphere, is soluble in three parts of cold water, and but little more soluble in hot. 100 grains of it contain 28.80 of acid, 50.09 of alkali, and 21.11 of water. In its general properties it resembles nitrat of potash.

#### CCCCCLXXVII.

Nitrat of ammonia is like the former, a preparation of art. It possesses like it a cool, bitter taste, is soluble in two parts of cold, and in half its weight of boiling, water. 100 grains of it contain 57 parts of acid, 23 of ammonia, and 20 of water. This salt is slightly deliquescent, and undergoes by heat the watery fusion.

#### CCCCCLXXVIII.

The salts formed with the nitrous acid are termed nitrites, in the same manner as already explained in detail of the sulphuric acid.

#### CCCCCLXXIX.

##### *Muriates.*

Muriates, or the combinations of the muriatic acid with alkalies, have in general a sharp taste. They suffer a decomposition from the sulphuric and nitric acids; but they are not decomposed by heat.

#### CCCCCLXXX.

Muriat of potash has a bitter, salt taste, is soluble in three parts of cold, and two of boiling, water. Its pro-

portions consist of 46 parts of alkali, 36 of acid, and 18 of water.

## CCCCCLXXXI.

Muriat of soda is the most abundant salt in nature. To it the water of the ocean owes its saltiness; and it is found in three different states; in the ocean, in springs, and in rocks, or in immense strata. In warm climates it is procured by spontaneous evaporation; but in cold countries it can only be procured by evaporation, the consequence of the application of heat. It is generally impure in its first process, by the admixture of other salts, which render it deliquescent, and give it a bitter taste, and various processes are employed to purify it. In this last state it acquires an agreeable, saline taste. It is soluble in rather less than three parts of cold water, and is the same in hot water. Its proportions are 35 parts of soda, 40 of muriatic acid, and 25 parts of water.

## CCCCCLXXXII.

Muriat of ammoniac is native, but for most uses is prepared by art, and chiefly by sublimation. It is acrid and urinous to the taste. It dissolves in three parts and a half of cold water, and in equal parts of boiling water. Its proportions are 40 parts of ammonia, 52 of acid, and eight of water. It is decomposed by lime, and a caustic, or pure ammoniac produced.

## CCCCCLXXXIII.

*Fluates.*

The fluates are as yet unknown in medicine, and therefore need only to be barely mentioned.

## CCCCLXXXIV.

*Borates.*

The borates are distinguished by communicating a green colour to the flame of alcohol.

The borat of potash is little known. The borat of soda forms the common borax of commerce. In its taste it is cool, somewhat alkaline, and changes vegetable blue colours to a green. It is soluble in 12 parts of cold, and in six parts of boiling, water. Its proportions are 34 parts of acid, 17 of soda, and 49 of water.

Borat of ammonia can hardly be obtained in the solid state, and has never been applied in medicine.

## CCCCLXXXV.

*Carbonates.*

At this place it may be proper to consider the neutrals formed by the combinations of the carbonic acid with the alkalies, forming a class named carbonates.

Carbonates possess the distinguishing property of effervescing, on being mixed with acids, the carbonic acid being thus detached from their base, and flying off in the gaseous state.

## CCCCLXXXVI.

Carbonate of potash, or aerated vegetable alkali, is usually in the form of a white powder, of an acrid taste, with some causticity, though not equal to the pure alkali. It is soluble in four parts of cold water. Its proportions are 23 parts of acid, 70 of alkali, and five of water. This salt may be varied in its proportion of acid, and accordingly it is formed occasionally as a sub-carbonate, or with an excess of alkali, and at other times as a super-saturated carbonate, with an excess of acid.

## CCCCLXXXVII.

Carbonate of soda is that state in which soda is usually prepared, combined with carbonic acid. It possesses an alkaline taste, with little acrimony, and changes vegetable blue colours to a green. Its proportions in 100 parts are 16 of acid, 20 of alkali, and 64 of water. It is soluble in two parts of cold, and in its own weight of hot, water.

## CCCCLXXXVIII.

Carbonate of ammoniac is a concrete salt, so volatile as to exhale at the common temperature. It possesses a pungent, ammoniacal odour and taste, is slightly caustic, and changes vegetable colours to a green. It is soluble in twice its weight of cold water, and in less than its own weight of boiling water. Its proportions are 43 parts of alkali, 45 of acid, and 12 of water; though these vary according to the temperature at which it is formed, the proportion of the alkali being from 20 to 50 in the 100.

## CCCCLXXXIX.

The vegetable acids, in the same way as the mineral, form with the alkalies different neutral salts; but these, except a few, are little used in medicine, and therefore claim slight attention, compared with the mineral neutrals. Many of them also have been so lately discovered, that their qualities are not yet appreciated. We shall only therefore notice the few that are really known.

## CCCCXC.

Tartar, or potash, super-saturated with tartaric acid, is formed on the side of tartar, and requires for its fermentation of wine  
under the n<sup>o</sup>



solution 100 parts of cold, and 28 of hot, water, though its solubility may be increased by the addition of borax. By the addition of potash the tartarite of potash is formed, a salt of a bitter taste, deliquescent, and soluble in water. If, instead of potash, soda is used to neutralize it, Rochelle salt becomes the production.

## CCCCXI.

Oxalate of potash, or salt of sorrel, is little used in medicine, but possesses the quality of eradicating stains from linen, and is much employed for this purpose.

Acetite of potash appears in the form of a white foliated mass, extremely deliquescent, and is soluble in little more than its weight of cold water.

Acetite of ammonia can scarcely be crystallized, as it is partly volatilized with the water, when its solution is evaporated, and partly decomposed.

## CCCCXCII.

Of the animal acids, few or none, except some of the preparations of phosphorus, have been introduced into medicine.

Phosphate of soda is a crystallized salt, with a slight excess of alkali. It is soluble in three parts of cold, and in half that quantity of hot, water.

Phosphate of ammonia is a constituent part in the urine of carnivorous animals. It is obtained pure by the direct combination of its principles. It is soluble in four parts of cold, and in a less quantity of hot, water.

The ~~hitherto deemed the~~ CCCCXCIII.

Substances which have been  
in medicine, and

before the gaseous fluids were understood, they were considered as the most powerful agents in chemistry. Different theories of physic have been formed from their supposed action on the fluids, and an acquaintance with the gaseous bodies has again, in some sort, renewed those doctrines which the operation of the saline remedies originally introduced. We shall examine their effects, according to the arrangement already observed, prosecuting them first in their simple, and afterwards in their compound, state.

## CCCCXCIV.

In investigating this subject, the first observation that occurs is, that we find no simple salt in the human body, but always in a state of combination; and wherever it exists in a simple state, it is the effect of disease, and of the action of the system being improperly exerted, so that the connection of the simple salt with its base is prevented. This forms a leading clue to the use of saline remedies, and that where they are meant to pass beyond the *primæ viæ*, or into the system at large, they should be introduced in their simple state, so as to remove that deficient combination which disease, as its consequence, produces.

## CCCCXCV.

Our knowledge, however, of the animal fluids is as yet very imperfect, and the proportion of their component parts, in health and disease, has not been so far ascertained as to lead to any regular conclusions on the subject. From the fluids, however, we know that the solids are entirely formed, and any cause which produces a change on the chemical combination or proportion of

their fluid parts, must influence the state of the solids, and lay the foundation for disease. The humoral pathology, therefore, we shall always find just, to a certain degree, and that in chronic diseases particularly it claims a greater share of attention than it has yet received.

## CCCCXCVI.

The use of alkalies against certain diseases has been long known. Of all others, however, their effects against calculus have been most successful; and this practice began soon after the commencement of the last century. They were first proposed in the form of salt of tartar, and at a later period they yielded to that of soap and lime. But though the disease was mitigated, and the pain and irritation assuaged, still their collateral bad effects were considerable, as they were often used to most enormous extent. To preserve the efficacy of this remedy, and avoid its hurtful consequences, the most rational expedient appeared to be, in some degree, to neutralize it. The alkali, therefore, supersaturated with carbonic acid, was the form resorted to with this intention, and the salt of tartar, in solution, was directed to be impregnated by means of the apparatus for impregnating liquids with fixed air, by exposing the solution to a stream of it for 48 hours. The effects of this impregnation, while it alleviated its hurtful tendency on the constitution, were to produce, in many patients, those symptoms which arise from intoxication, and which prevented its use to the extent their malady required. Hence it has been recommended in the form of the fossil alkali, or *sal sodæ*, with soap.

## CCCCXCVII.

The chief effect of alkalies, in any form in this disease, is to produce a speedy and complete abatement

of pain. They are most effectual in cases after the prime of life ; and, indeed, this disease is mostly confined to that period. Their mode of operation is still undetermined. That a discharge of calculi, or gravel, follows their use, so soon as they begin to act, seems constant and regular ; and that the secretion of urine is actually changed by them, is also ascertained by the usual test of turnsole. That an acid is present in the urine, chemistry has abundantly detected ; and that this acid is much increased, in certain diseases, has also been observed. From these facts, we have reason to infer that a chemical combination first takes place, and that the sand or gravel which follows the first use of the alkalies, is the production of this combination, while the state of the secretions is afterwards so changed, that the morbid excess of acid is entirely done away, and the opposite, or an alkaline disposition, produced. The particular kind of this alkali, however, has not been examined ; but so strong is the power of acids in producing this disease, that patients have felt an immediate return of it from acids alone, especially in the form of stale malt liquors. The same has been observed by many patients on the drinking of wine, and the similarity between the concretions of this disease and of gout is a strong confirmation of the same fact.

## CCCCXCVIII.

Besides in calculus, alkalies form remedies well adapted to the diseases of infancy. During childhood a disengaged acid is present in the primæ viæ, frequently in such excess as to induce morbid symptoms. The alkalies here are the most successful means of cure, joined with aromatics, and they are particularly indicated by the acid

smell of the stools. In general the volatile alkali is reckoned the most powerful,

### CCCCXCIX.

Alkalies are also employed, with success, in particular species of ulcerations, either when appearing as an original malady, or as a consequence of venereal contagion, where an excess of oxygen has been introduced into the system by means of mercury for its cure. The vegetable alkali has been here the remedy employed, and has often effected a complete removal of this state.

### D.

In scrofula the fossil alkali is reckoned a very useful preparation, and frequently removes the obstruction of the fluids, and it is used either in the sal sodæ, or burnt sponge, both which derive so little advantage from their carbonic impregnation, that to the alkali alone the benefit attending their application is to be referred.

### DI.

Externally the alkalies are frequently used as caustics, and the volatile kind makes a powerful rubefacient in cases of fixed pain and spasm.

### DII.

From the alkalies we proceed to the effects of the acids; and on this subject, of the simple salts we may observe, that they are each a class of remedies, of powerful operation, and that the continued use of either soon induces an actual morbid state. This is particularly the case with the second division, or the acids. They consist all, as formerly observed, of oxygen, with a combustible base. The proportion of oxygen necessary to the supply of life, from the quantity received by respiration, does not seem

to be very great, and an excess of it will therefore act as a powerful means of inducing disease, in proportion to its efficacy as a remedy. Till the effects of respiration, on the one hand, and the composition of acids on the other, was fully known, no proper theory could be formed of the mode of operation of some of the most successful medicines in use. But by this knowledge we find that the most powerful combinations are the effect of the oxygen they contain and impart, on their introduction into the body; and that to this principle their activity, as medicines, is owing. Hence the use of oxygen, in its greatest quantity and in its mildest state, by means of the acids, has of late formed a new field of practice, and their powers have been particularly called forth to check the progress of one disease, the specific for which has been often attended with dangerous and fatal consequences to the constitutions of patients. This is the venereal disease.

### DIII.

The acid preferred for counteracting its contagion has been the nitric, as containing oxygen in the greatest proportion. It was first brought forward to modern notice by Mr. Scott of Bengal. The variety of trials which have been made with it, and the assiduity with which these trials have been prosecuted, we may consider as having exhausted the subject, and that the real merit of the acids, in this disease, seems fully appreciated. The candid conclusion to be drawn is, that they are medicines of much benefit in particular states of this malady, and these states we shall endeavour to define with some precision. Wherever dyspeptic symptoms are present in a great degree, and much debility of constitution prevails,

provided an actual hectic fever does not attend, the use of the acids will be highly serviceable. They will be found to improve the general health and strength. They may be therefore made either to alternate with mercury, or they may be given alone, till the constitution is so far repaired that it can sufficiently bear the action of the latter remedy. In peculiar cases of ulceration also, where mercury is found to increase the malady, the use of the acids is often astonishingly efficacious, both in an internal as well as external form. In venereal cases of old standing, particularly in affections of the bones, the exhibition of the acids, from the easily disengaged state of their oxygen, and their highly diffusible nature, is found to alleviate the symptoms in a very speedy and considerable degree. Nor are their advantages less extended to herpetic and other eruptions, over which they display the most marked success. The local inconveniences attending a course of mercury, particularly the profuse discharges, and foetid ulcerated state, is more speedily and effectually relieved by the internal use of acids than by any other medical treatment hitherto employed; and to counteract these effects, it may be trusted to with most implicit confidence. Neither in their exhibition should they be carried too far; but the propriety of their application is generally shewn very speedily, for if no improvement of the general health, or increase of vigour quickly occur, they are seldom effectual, and they may be laid aside.

#### DIV.

On the whole, the acids are by no means remedies of general and indiscriminate application in venereal complaints. They are suited to the particular situations we

have pointed out ; and though a complete cure may not be effected by them, much relief will attend their exhibition.

**DV.**

The form in which oxygen is applied, as well as the principle itself, seems important to the cure of this disease. In the form of gas it possesses no influence at all. In the form of the acid it is speedy in its relief, though not fully complete or permanent in the cure. But in the form of mercury, when it is united to a metallic base, and extricated in the system, in this state it proves, in almost every case, a certain specific for this malady.

**DVI.**

By some authors it has been alleged, that the sensible effects of mercury and the acids are not strictly analogous to each other, for the salivation induced by the acids, it is alleged, is different from that induced by mercury ; that no looseness of teeth attends it, nor the spongy gums, or foetid breath. Of this, however, sufficient observation has not yet been made ; but if so, these symptoms would seem entirely the effect of the metallic base, not of the oxygenous principle of the remedy.

**DVII.**

As the acids are substances of such powerful operation, so likewise we find their exhibition, as well as that of mercury, liable, in many constitutions, to produce dangerous consequences. These consequences consist in affections of the primæ viæ, as nausea, vomiting, or flatulence, heartburn, and pain of stomach ; or else heat of bowels, diarrhœa, dysentery, or constipation ; in affections of skin, as heat, itching, or miliary eruption ;



in fever or nervous affections, and in several disorders of the secretions. These effects, however, are but rare, compared with the benefit derived from them.

#### DVIII.

But though the nitric we have mentioned as the acid most relied on in venereal complaints, the muriatic also deserves its share of credit. It was first introduced with this view by Dr. Zeller, and he found it particularly effectual in the venereal ulcerations of scorbutic habits, and where a dissolved state of the fluids was conspicuous. In such cases the advantages of its use were even more speedily conspicuous than those of the nitric acid; but it required to be used to considerable extent, in order to accomplish this effect.

#### DIX.

In the venereal disease the vitriolic acid has been the one of the fossil acids the least employed. It seems only to act here as a general tonic, without any appearance of specific operation; and its oxygen, therefore, is perhaps more fixed by its base, or not so easily disengaged as the others.

#### DX.

The vitriolic acid has been chiefly used as a temporary remedy, to prepare the constitution, in venereal cases, for the introduction of mercury, where a peculiar weakness of habit, dyspeptic symptoms, or profuse discharges, forbid the immediate exhibition of the specific. But it seems to have less power in arresting the progress of this disease than the other mineral acids, and is therefore by no means the most useful tonic, either to suspend its course, to heal its ulcerations, the consequence of the spe-

acid, or to lessen the increased discharges from the latter. It has been much recommended also in cutaneous eruptions of the herpetic and psoric kind, and here it has been attended with the most certain and marked success, and is much more cleanly in its application than the sulphur. But if this acid has been little used in venereal cases, it has been more extensively employed than the other two in a number of different maladies.

## DXI.

The vitriolic acid has been employed very extensively as a tonic in all cases of passive discharges, and where no inflammatory disposition of body is present. The muriatic acid, though not so generally employed, is possessed, as a tonic, of more active powers. In typhus it has been employed on the continent with most decisive success, and used in very liberal quantity. In the fevers of children it acts frequently as a specific. Where used, however, simply as a tonic, in chronic cases, it must be exhibited in small quantity; but where it is had recourse to in the active febrile state, this rule must be reversed. Externally the muriatic acid has been applied in the form of a bath to the feet, in gout. In a late publication there are accounts of its successful application as a lithontriptic.

## DXII.

Next to the mineral acids has been placed the boracic, but it has been chiefly used in the form of Homberg's sedative salt, in which form it was supposed to possess powerful anodyne virtues, and from which it derived its appellation of sedative. These virtues have not been realized by succeeding practitioners, so that it is now

entirely laid aside. The fluoric acid has not yet been introduced into medicine.

### DXIII.

Of the vegetable acids, the citric claims the principal attention; it forms what may be considered as a specific in scurvy. This disease, it is clearly established, arises from a gradual abstraction of oxygen from the system; and the livid colour of the blood, and every other symptom, confirms it. Hence every means of supplying oxygen afford a certain chance of cure. But though this general principle is clear, and that the morbid state may be removed by most of the remedies of this class, the citric acid has been found the most speedy and effectual, and has therefore claimed a preference. Previous also to the introduction of the mineral acids for the cure of lues, the vegetable acids, in this form, we are informed, were employed for the same purpose. The particulars of this practice were the exhibiting to the extent of 11 or 12 Seville oranges daily, either in the pulp or strained juice; but this remedy was found even less effectual than the mineral acids, and was hardly capable of at all suspending the progress of the disease. In the warmer climates the citric acid forms a useful application, externally to ulcerations, and is much employed for that purpose in the yaws and cutaneous diseases.

### DXIV.

Of the other vegetable acids, few are used in medicine, except the acetic and acetous. The malic is chiefly employed as an article of diet, in the fruit which produces it. The oxalic is also used only in the same way. The benzoic is a medicine of long use, under the name

of the flowers of benzoin. Formerly it was prescribed in pectoral complaints, but with little efficacy. The acetous acid is the only one then of this class that claims farther notice. This acid is used very extensively, both in diet and in medicine. In the latter case it is a useful antiseptic, and is applied in a variety of forms, both externally and internally, with this intention.

## DXV.

All the vegetable acids form powerful antidotes against narcotic or vegetable poisons, though the citric and acetous are chiefly had recourse to with this view. Though modern chemistry has detected a great variety of vegetable acids, yet the greater part of these seem resolvable into two, the oxalic and acetic; and from this circumstance they may be perhaps considered rather as varieties of them, depending on some peculiarities in their combination, than as original compositions of this class.

## DXVI.

Of the last division of the acids, the animal, there are only two species used in medicine, the lactic and phosphoric. The lactic is employed under the form of sugar of milk, and is made in Switzerland in considerable quantities. It has been reckoned by some, though on no good foundation, a specific for gout, though its sensible qualities do not evince sufficient powers to have any influence over this disease. The phosphoric acid is a medicine of peculiar properties, although these have not yet been fully appreciated. From the reports, however, of the German physicians, we are induced to consider it as exerting a powerful stimulant operation on the system.

## DXVII.

From the experience of those who have employed this remedy, it is found well suited to those low states either of fever or nervous affection, where a powerful and universal stimulus is wanted. It produces, by its action, an universal heat and glow, and quickens the pulse, rendering it at the same time strong and full. It is one of those rapidly exciting means which is only safe where the vital powers are extremely low. Hence it has been used with much success in typhus, even after the worst symptoms have appeared, as involuntary stools and discharge of urine; and its effect has been to restore the natural animation of the system; to produce an increased vigour and glow, and to follow up this with a full and general perspiration, so as to terminate the disease. But like other powerful medicines, this remedy has often been attended with the worst consequences, where improperly used, and it is only in cases where every chance of recovery is past, and where the vital powers seem as it were altogether suspended, that its most successful operation has taken place. Indeed the accounts narrated of it, in such cases, savour somewhat of the marvellous.

## DXVIII.

Such is the general action of the simple salts, a form in which they are never naturally presented to us in the human body. To produce, however, great or permanent changes as medicines, it is in their simple form that they ought chiefly to be exhibited. From the time that chemistry made some progress, the exhibiting them in their compound state was preferred, and the labours of chemists were chiefly employed to find out combinations which

should possess qualities for the eradication of disease, suited to the chemical ideas or theories of medicine then prevalent. The general effect of the compound salts is to open the several excretions in a greater or less degree, particularly those of the intestines and kidneys, &c. We may therefore perhaps infer, that an effect of the presence of compound salts in the blood is to act upon the secretions, and render the useless parts of the fluids more easily determined to those organs which are to separate them, and make them pass off, and thus to prevent an excess of azote being formed.

## DXIX.

The combinations with the sulphuric acid compose the first division with the neutral salts. The two first articles, the sulphates of potash and soda, are merely purgative, and possess no other operation. The second of them is present in several mineral waters, and gives them a laxative tendency. It is more soluble in the animal fluids than the first, and is accordingly more active in its operation. The sulphat of ammonia is not used in medicine.

## DXX.

The second division, or the combinations with the nitric acid, are more extended in their operation on the animal economy, at least the first of them, the nitrat of potash, or common nitre. It is considered to have a considerable influence in lowering the frequency of the pulse. Hence it is employed as a refrigerant and sedative in all active inflammatory states; and by particular combinations it is brought to act powerfully both on the kidneys and skin. In the form of gunpowder it is employed by some practitioners, as a most successful remedy in dropsy.

The nitrates of soda and ammoniac are not yet known as medicines.

### DXXI.

The combinations with the muriatic acid follow next in order, and they are highly subservient to the various purposes of life, both in diet and medicine.

The first of them, the muriat of potash, was formerly held in high reputation in fever, under the name of the febrifuge salt of sylvius. This reputation it is no way entitled to, in preference to many other substances of this class, and it has accordingly been neglected. This salt is present, in a certain proportion, in the animal fluids, and oxygenated it has lately been introduced as a new remedy in venereal ulcerations.

Muriat of soda is more employed by mankind than any other saline substance whatever. It forms, as it were, a necessary ingredient in the animal œconomy, and the analysis of all the fluids and solids detects its presence.

The muriat of soda possesses evidently, out of the body, an antiseptic power on animal substances. At the same time, taken in too largely during life, it hastens the septic process, and proves one of the chief sources of one disease, the scurvy at sea. That its use seems necessary to the animal system appears from the strong desire that many animals discover for it, and they are generally fattened with half the quantity of food by its use. This will tend to confirm the opinions lately adopted, of the formation of fat depending on the deficiency of oxygen in the system.

The muriat of ammoniac is also a medicine of considerable utility. It is used internally as a powerful stimulant, and antiseptic remedy, in intermitting and some other fevers; and externally, it discovers strongly

the same qualities in gangrene and asthenic inflammation of particular parts. In some species of inflammatory tumours and obstruction, it proves a most successful discutient.

## DXXII.

Of the division of carbonates, the two first have been chiefly employed, as we formerly noticed under the head of alkalies, for the cure of calculus, and the bad consequences attending a constant and large use of the alkalies has been supposed counteracted by this combination.

Carbonate of ammonia is much employed as a cordial and exhilarating remedy in nervous cases. It was supposed also specific against the morbid effects of the poison of the viper; and from this circumstance its exhibition was extended to venereal complaints. But in this last disease, although it occasionally relieves symptoms, suspends the progress of the malady, and gives ease in pain, it by no means has any claim to specific powers. From its strong stimulant nature, this combination has an influence on all the secretions, and will therefore be useful in every case of obstruction, where no phlogistic diathesis attends.

## DXXIII.

The combinations of the boracic acid are little used in medicine. The sedative salt was already noticed, and the powdered borate of soda is a common application to aphthæ.

## DXXIV.

Of the vegetable acid combination, the chief used in medicine are those with the tartarous and acetic acids. The purified acidulous tartarate of potash forms a useful



diuretic in dropsy, and is a safe mild laxative in all inflammatory states. The real tartrate of potash, or soluble tartar, possesses the same properties, and the tartrate of soda is equally efficacious.

The acetate of potash is now little used, but it formerly had reputation as a powerful deobstruent remedy, and the combination with soda possessed the same properties.

The ammoniacal acetate is now in most repute, and its solution is considered as a mild diaphoretic in all inflammatory diseases, where an attempt is made to remove the morbid constriction of the skin, and it forms a gentle discutient and antiseptic in cases of external inflammation and swelling.

#### DXXV.

Of the combinations with the animal acids, few or none have been introduced into medicine. The only one to be noticed is the soda phosphorata, which was considered as a laxative, acting without producing any griping or pain, and therefore as claiming a preference over the other saline remedies of this nature; but experience has by no means justified this opinion of it held out.

#### DXXVI.

From this view of the class of salts, considered as medicines, it would be of much importance, in order to their application in the compound form, that their relative existence and proportion in the animal system could be more fully ascertained. By this knowledge alone could a proper selection of them, as remedies, be made. A disengaged acid we find frequently present in the primæ viæ, but it seems to pass no way farther. An alkalescent state is

clearly marked in various cases of disease. The compound salts are procured, in different proportions, from almost every part of the animal frame. All these circumstances give an importance to this class of substances, which calls for the investigation of the physician into their specific relation to the human body, as a foundation for their fuller application to the cure of disease.

## DXXVII.

CLASS V. *Earths.*

Earths, the fifth class of bodies, may be divided into five different kinds; and these kinds are,

1. The absorbent or alkaline earths; 2. The clays;
3. The stony or siliceous earths; 4. The fusible earths;
5. And lastly, the talky or flexible earths.

## DXXVIII.

The absorbent, or alkaline earths, are found of many degrees of firmness or hardness, from the state of loose earth to that of hard stone; but they never scratch glass, or give fire with steel; and by applying the edge of a knife, an impression may be made upon them. Their most distinguishing and most remarkable quality is, that of effervescing with acids, which may be observed by applying a single drop of aqua fortis to the surface of this kind of earth, when it immediately works upon it, and rises into foam.

## DXXIX.

The clays are friable or moist earth, which mixed in a certain proportion with water, forms a tough or ductile paste, and when burnt they become excessively hard, but cannot be melted in any strong fire.

## DXXX.

The flinty earths comprehend always the hardest stony masses of various sizes, the principal quality of which is excessive hardness; it is so great that these bodies cut or scratch glass, as the diamond does, though not so effectually; and they give fire with steel, or when struck in a particular manner, they throw out flashes of fire. The particles of steel being torn off, are afterwards in a state of calcination, and a file makes no impression on them; but, on the contrary, they wear down the file.

## DXXXI.

The fusible earths comprehend firm stony concretions, that are neither so hard as the flinty, nor so soft as the absorbent earths. They have a middle degree of hardness, but do not strike fire with steel. Their most remarkable and distinguishing characteristic quality is their fusibility, which appears in them when they are strongly heated.

## DXXXII.

The last class, the talky earths, are concretions of a seally, flat, or fibrous structure. They have no great degree of hardness, they are easily scraped with the knife, and their distinguishing quality, besides the structure mentioned, is, that they suffer very little change upon being exposed to a pretty strong heat.

## DXXXIII.

In considering the origin of these earths, it may be remarked, that surveying the face of the globe, and the accidental changes it has undergone by water and other causes, and especially by going into its bowels, it can be

observed, that it is either formed into beds or layers, parallel to one another, or into masses enormous in their size, but quite irregular in their thickness and external form; the first are called strata, the second rock, or rock-stone.

## DXXXIV.

These appearances are not to be perceived at the surface, which is every where covered with a confused rubbish of the materials, which lie more solid and regular below, and a part of which has been often broken down, and carried to a considerable distance, by the water moving along, and by other causes; but this rubbish must be broken through before these appearances can be seen.

## DXXXV.

An example of what has been mentioned is to be found near Edinburgh, at the north end of Salisbury craigs, where a considerable part has been carried away. The stratified matter may be seen very distinctly, and the rocky stone, the greatest part of the stratified matter underneath consists of parallel beds or layers, a little interrupted here and there; but the number is exactly the same through all that part, and the thickness of each bed is precisely the same through the whole of its extent. Over this there is an example of the stony matter called rock, a mass of matter the parts of which are not arranged in any regular order; over this again there is an example of a small quantity of matter stratified, similar to what is below; and appearances similar to this are to be found every where, in digging deep into the earth.

## DXXXVI.

In general the quantity of strata exceeds very greatly

that of the rock, especially in countries that are tolerably smooth and even. Such are composed of strata of an equal thickness, through a great extent of country, so that when the workmen sink a shaft into a mine or coal-pit, they know the materials they have to pass through. If they have to sink another, at a considerable distance, they meet with, perhaps, a bed of clay, then of sand, then a quantity of more clay, after this free-stone, &c. And if they have occasion to sink another, at the distance of many miles, they will pass through the same materials, of the same thickness, and arranged precisely in the same order. So these are spread out and extended in this manner, in beds of equal thickness, to a great extent of country. At the same time this regularity is chiefly to be met with in countries that are smooth and even upon the surface; it is more general where the surface is uneven, to find the strata inclined to the horizon, or, to use the term of miners, dipping; and sometimes they dip in one place and rise again in another, and perhaps again descend, so as to follow the waving of the surface of the ground; at other times they sink much farther down. Wherever the degree of strata comes up to the surface, as in the cutting of roads on the banks of rivers, &c. we have such an appearance of the edges of strata at the surface of the ground, and these are called cropping of the strata; and it is this that produces a variety of soils, which are composed entirely of a rubbish of these materials that are lying more solid below, intermixed with the putrid remains of animal and vegetable matters.

## DXXXVII.

Such is therefore the distribution of the materials on

the smoother parts of the earth ; but in the mountains we find a greater quantity of rocks, which having been surrounded or intermixed with the softer parts, has withstood the impressions of time, and now remains, after the other places are washed away. In this way are produced many mountains and extensive ridges, which from their form show they are the cropping of hard strata, the softer parts of which have not withstood so well the waste of time. Generally on the one side is a little declivity, and the other side a steep, with a quantity of rubbish at the bottom, fallen from the top.

## DXXXVIII.

It is necessary to observe, that both these strata and rocky masses are found cracked, or broken across in different directions. The more general direction is perpendicular, and these rents and divisions are generally filled with some other matter different from that which composed the rock or stratum. These are called veins in mineralogy, the matter filling them up is very various ; but it is generally a stony matter of a foliated structure, to which the general name of spar is given, which turns out various on different occasions, every stony matter thus formed of hard and rocky matter being called spar. These rents or cracks are of different wideness, from a few inches, or parts of an inch, to several feet or yards ; and it is in the matters that fill them up that the ores of metals are generally found.

## DXXXIX.

There are some divisions that are met with of softer strata, consisting of other matter not of the stony kind, and these are called banks by the miners or colliers, and

they prove a great interruption to the working. When there is thus a sudden interruption of the whole stratum, and it entirely disappears, the colliers proceed further till they come to other matter; from examining which they form some judgment where the coal lies, that it is either below, or somewhat above the level in which they have been working. Having passed such a stratum of matter in sinking before, experience has taught them the different situation of the materials to one another; and very often the strata is disturbed in this manner, that there is a division or rent formed, and along with this the strata has slipped a little below the level where they are working. Thus from their knowledge of the nature of the strata, they conclude that the coal is below them, and they sink down to get at it; or upon other occasions they find it risen. These are called slips, where there is simply a division or change of the level. Where they are placed at a distance at the same time, and a great quantity of matter introduced, that is called a bank, or they give it the name of a *trouble* or *disturbance*, in the arrangement of the strata.

## DXL.

With regard to the veins, we find masses of rock and harder strata; that wherever any part is left not filled up with the spar, where there are any holes, the internal surface is beset with crystallizations of the matter with which the veins are filled. These are of various kinds of spar, and other stony matters, formed into regular crystals; and even the metallic substances are crystallized in the same manner, when they are found in such veins.

## DXLI.

Such are the phenomena in general, that have been observed with regard to the earthy and stony matters of this globe; and the same phenomena have been observed over the whole of its surface. They are so curious, that they could not fail to produce many attempts to explain them. Many conjectures have been offered to account for their origin, and it will be found that, in general, all those who have made any attempts of this kind, have gone upon the supposition that the general arrangement has been performed by means of water; that this regular distribution into strata is in consequence of a diffusion and separation of the materials from water; and when the arguments upon which this supposition is founded are well considered, they no doubt give an undeniable proof that this is the case; because we find in these strata either the reliëts of marine productions, as shells, &c. or, at least, there are none of the strata but what are either above or below strata that manifestly contain the productions of the sea. When this fact is well considered, it is an undeniable proof that this regular arrangement has been produced by a deposition of its materials, gradually from water, perhaps in the bottom of the sea. But besides this regular arrangement of the strata, there are many other facts that cannot be explained upon this principle. The inclination to the horizon that is so remarkable in the strata in most places, which is sometimes so great as to place them upon their edges, cannot be explained in this way; nor the extensive ridges of mountains in which the strata are very often thrown into great confusion.



Some have supposed that this kind of confusion, and these divisions and rents, have been occasioned by repeated earthquakes, which we know produce effects similar to this. We have records of considerable tracts of countries being suddenly laid under water, and of islands appearing raised from the bottom of the sea, in consequence of eruptions of burnt or melted matter, produced by subterraneous fires or volcanoes, which continued raised to a considerable height above its surface. Others have supposed that this happened at the deluge, which threw the world into a sort of confusion, compared with the state it was in before. Others have supposed that this world received a stroke from a comet, which by the violent shock has thrown its materials into confusion. And Buffon again imagines that the ocean is making a gradual progress over the surface of the globe, wearing away from some shores and adding to others; so that there is not a spot of the globe that has not been once covered with the sea; and that those parts presently covered with the sea are receiving an addition of matter that will prove sufficient to raise them over its surface, in a certain length of time. But we cannot enter so particularly into this subject, as to explain all the theories that have been offered. Upon the whole, the phenomena show that the materials of this globe have undergone a very great change; that what was once covered with water is now mountainous, and what was once above the surface is now at a great depth under water; and that these changes have been often repeated, though the succession of them has been extremely slow, and has required a very great length of time.

## DXLIII.

Of the absorbent or alkaline earths, there are several kinds which are insipid bodies, and shew no sensible degree of solubility in water. Their character is, that they effervesce with acids; and such is their nature, that they bear plainly the same relations to acids as alkalies do, so are frequently called alkaline earths. In general, they unite with acids only in one certain and steady proportion. If there is more of the absorbent earth added, it is not all dissolved; or if a small quantity only be mixed with the acids, less than what the acid can dissolve, it is only united with a part of the acid, and the rest remains free and disengaged. There is the same mutual saturation here, as between the alkalies and acids, and the compound is analagous to the neutral salt. It is soluble in water, and separable from it by evaporation and crystallization. The acid is hereby fixed, and its acrimony greatly diminished. No acid taste is perceivable in the compound; it does not alter the colour of the vegetable infusions; and these earths attract the acids precisely in the same manner as they are attracted by the alkalies. So they resemble the alkalies in every particular, almost with regard to the nature and mode of this attraction; but the force, upon the whole, is weaker than that of the alkaline salts, so that any compound of them can be decomposed by an alkali, and the absorbent earth be made to fall down in the form of a white powder.

## DXLIV.

These properties are applicable to the earths in general. We shall next consider the various kinds of

them. That which occurs the most copiously, being at the same time the most useful, is the

## DXLV.

*Calcareous Absorbent Earth.*

It is distinguished from the rest, by the effect which fire has upon it, which converts it into quick-lime, from whence it has its name of calcareous. It appears in a variety of forms. There are very considerable strata of it in the bowels of the earth, as lime-stone, marble, and chalk, which differ only in the degree of purity, or mode of concretion, forming a mass, the parts of which cohere more or less strongly.

1. There are as extensive beds of this species of earth found as of any other kinds whatever; so may be considered as among the most abundant production of nature.

2. It is often also found in veins, or filling up the rents and cavities of the mountains; and it is called *calcareous spar*, to distinguish it from some other kinds of spar, some of which contain a quantity of this earth, but not in so pure a state. It resembles a whitish stone, which has more or less transparency, when it is called spar, and when it is broke into pieces it is of a rhomboidal figure, and it shews, at the same time, manifestly a foliated texture, when it is examined by the microscope. Some of these kinds that are purer, are perfectly transparent; and from their being found in Iceland, this species is called *Iceland crystals*; but that name belongs to a different kind of stone. This transparent stone is remarkable for refracting light, so as to make a ray of light appear two, without at the same time dispersing the colour; it makes every letter or

stroke of writing appear double. In the veins of the calcarious spar, where any part is not totally filled up, the internal surface is found lined with crystallizations. The appearances of these are very various, the crystals being formed into a number of different shapes. What particular circumstance influences them to assume these particular appearances has not been discovered. Some of them are pyramidal, others are columnar of six sides, the two sides opposite being always unequal, and terminated by a very obtuse pyramid; or the crystals are flat, without any column that is perceptible. In others the pyramid is a little longer, with a short column, or the spar is formed into long crystallizations, closely compacted and disposed in a radiated shape, proceeding from a central point towards the circumference of a sphere, &c. These crystallizations are always found in the internal surface of veins, the other parts being filled up with calcarious spar.

## DXLVI.

The matter with which the vegetable and animal matters are incrustated or penetrated by the waters of particular springs, so as to retain not only their external form, but to lose their nature, and become stone, is generally of this kind. This shews that this earth is capable of being dissolved by water, and of being introduced into the texture of animal and vegetable substances. We have examples of this in England, at the dropping well at Knaresburgh, and in Hamilton park, in Clydsale in Scotland. In general, the quantity of earthy matter is very small in these waters that are possessed of this petrifying power, and the process of petrification goes on very slowly. This earth too produces the large pen-

dulous columns and cones that are found hanging from the roofs of large caves, like icicles formed in frosty weather. A noted example of this is a cave at the Peake in Derbyshire; they are called *stelladites*. On other occasions, this matter concretes into a more spongy and irregular form; it encrusts the surface of the rock, or forms broad hanging plates, like curtains.

#### DXLVII.

The stony shells of all crustaneous animals, from the coarsest to the coral and pearl, are all composed of this earth and a small quantity of animal glue; a viscid fluid proceeds from the surface of the animal, which becomes a tough membrane, and gradually hardens into this form. So egg shells, and these marine bodies, which from their resembling plants, while at the same time they have the hardness of stone, are called *lythophyta*, *millepores*, *madripores*, &c. which the late naturalists now suppose to be in part animated bodies. The shells of all kinds of animals, together with all coralline concretions, consists of the calcarious earth, united only with a small proportion of animal glue.

#### DXLVIII.

Under these four forms the calcarious earths have generally a great degree of variety. But there are some fossil earths, which though not consisting entirely of these, deserve to be mentioned, as the earths called *marls*, which have been employed as manure to improve the soil. Every such substance that thus proves a manure, contains a calcarious earth, and is rich in proportion to the quantity of this. The earths of this kind are com-

monly divided into the shell marle, clay marle, and the stone marle.

## DXLIX.

The shell marle is composed of the shells of shell fish, or other aquatic animals, which are sometimes very entire, and often decayed, or mixed down with other earthy substances. Examining this matter as occurring in different places, it may be distinguished into fresh water, marle, and marle of sea shells. Of the first we have an example in Bruntsheld meadow near Edinburgh; wherever the soil is turned up, to the depth of six inches, a quantity appears; it is composed of the shells of a small fresh water wick or snail. This animal, when alive, is not easily discernable, the shell being much of the same colour as the stones covered with the water; but we can observe a great number of them in all running brooks and other collections of fresh water; when the animal dies the shells are deposited, where the water stagnates, in very great quantity. That composed of sea shells constitutes greater collections, and they are found in innumerable places, now far removed from the sea. That most particularly described is a collection of this kind in Touraine, a province in France. The part of the country where it is found, is computed to contain 80 square miles of surface, and where they dig to a certain depth, they find this collection of shells; and the country, at present, is 108 miles from the sea. They find the marle eight or nine feet below the surface, and when they dig to the depth of 20 feet it is still deeper, but they find it too expensive to search for it. It is supposed to be 28 feet deep only; and even at this depth the quantity will appear enormous,

it will amount to 140 millions of cubic fathoms of shells, that are mostly decayed and broken into fragments, and mixed with marine productions, as millepores, madripores, and other caroline, which are all the productions of the sea.

## DL.

The clay marle, again, are earths that bear more or less resemblance to clays. They are very various in their colour and other appearances, and disagree in nothing, except their containing a quantity of clay mixed with calcarious earth. Frequently the colour is reddish, sometimes of a bluish cast; others, again, are of a yellowish colour; but all agree in containing a quantity of clay mixed with calcarious earth, so as to effervesce with acids.

## DLI.

The stony marles have as great a variety in their colour and appearance. They are harder and more stony than the clay marles; but upon being exposed to the action of the sun and of frost, they fall down into clay, which is easily mixed with the soil, though some of them require a very long time before they are divided fine enough to be mixed completely with it; and this disposition to moulder down, depends upon an admixture of clay.

## DLII.

These are therefore the various forms in which the calcarious earth is offered to us by nature. Many of these forms are capable of receiving a fine polish, and many of them prove beautiful on account of their colour, and from hence arises their value. So coal is valued on

account of its colour and hardness, so that its parts can be made to receive a high polish. Also the lime-stone that is called marbles, in which this matter is concreted more firmly, so as to have a much closer texture, and to receive a fine polish, and some of the stellasites, which can be made into toys, receive a fine polish. The variations sometimes depend upon veins of spar traversing through them, sometimes upon shells and other marine productions, and they sometimes proceed from an admixture of various coloured earths, mixed with the calcarious matter, of which they are chiefly composed.

## DLIII.

Some compounds that have calcarious earth for their basis, fall next to be noticed.

The first are the gypseous concretions, that are commonly represented to us in the form of stony masses, which are remarkably soft, so as to be easily scraped with a knife. They do not effervesce with acids, like the calcarious earth; but when reduced to a powder, and boiled with a solution of the common fixed alkali, for some time, they change into a vitriolated tartar. They are found in strata of clay, in separate masses, and when pure are of a whitish, delicate, milky colour, and small pieces of them are often transparent, tinged with a reddish earth. They are often composed of small crystalline grains, and this species is called gypsum, or sometimes alabaster, where it has a considerable degree of hardness, and is capable of receiving some polish, so that statues made of it imitate those of marble. Besides they are often formed of a fibrous structure, and composed of oblong concretions lying across the mass, and they are called the libraria of



Dr. Little, but they do not differ from the rest, except in the particular arrangement of the particles.

## DLIV.

A third species, composed of clear transparent plates, which can be easily scraped with a knife, is found in some parts of Russia; their plates are so large as to answer the purpose of glass. It is called *glacies maræ*, or Muscovy talk.

## DLV.

A fourth appearance is in the form of straight oblong crystals, and then it is known under the name of selenites, and does not ill resemble the crystals of salt.

## DLVI.

Fifth. One of the kinds of spar contains a large quantity of this earth. It does not effervesce with acids, and is distinguished from all other stones, by its extraordinary weight, which is so great as to give a suspicion of its containing a great quantity of metallic matter. It has always a plated structure, and broken with a small throw, it thivers into fragments of a rhomboidal figure. It is called the *marmor metallicum*, from its being the matrix in which the metals are often found. It is composed of gypsum, combined with a small quantity of other earth.

## DLVII.

Lastly, it occurs also in water, and there in a small quantity; it always forms into slender filamentous crystals, like hair.

## DLVIII.

There is a third species of spar, which has been long

known in chemistry and natural history, as being different from the calcarious and gypseous spar; it is called the German felt spar, fluor, spatofus, &c. as it assists in melting the ore from stony matter. It is always found in veins never constituting strata; it has a close glassy texture, and is more or less transparent. It is often found crystallized in the cavity of the veins, and always forms cubic crystallizations that are sometimes colourless, but more commonly tinged either greenish, yellow, or purple. There are great quantities of it found in Derbyshire, which, on account of the particular arrangement of the crystals and flaws dividing them, gives them a very remarkable appearance, when polished.

## DLIX.

The second division of earths is into clays, which are among the most abundant substances in nature, constituting numerous strata in the bowels of the earth. Hence clay is often employed as a manure for improving the soil. A soil that consists of pure sand is the better of clay; and when it is used in this manner it is called marle; but that name is more properly applied to clay earths that contain a quantity of calcarious matter, and which is a useful addition to any soil whatever, even where there is plenty of clay, provided it has not received calcarious earth before. It is a substance, the particles of which are very fine and smooth between the fingers. A mass of it has the same smoothness of surface as a mass of hard soap.

## DLX.

Clays, in their natural state, are always moist. When dried, the parts cohere strongly together, and in that

state it has a strong disposition to imbibe water. By applying a mass of it to the tongue, by the sudden absorption of the water, it generally adheres to its surface. When it is mixed with a large proportion of water, and kneaded a little, it becomes a remarkable ductile, adhesive mass, which is not easily fusible in more of the water, and to render it thin it requires a great deal of work. Hence it is employed as a means of confining water in large works, as in making canals and dykes. Either the soil must contain clay, or a quantity brought by the water is deposited at the bottom, that renders the dyke capable of containing the water. Hence we can understand the bad effects that arise from allowing cattle to tread much in clay grounds, when they are wet; the clay is reduced to such an adhesive mass, that it does not admit the roots to penetrate the soil, or the water to enter to the roots.

## DLXI.

Though these are the most obvious qualities of this sort of earth, the variety of clays is very considerable, with respect to the fineness and softness of the particles. Some melt with the saliva in the mouth, others feel more or less gritty between the teeth. Some are of a whitish colour, some grey, bluish, or reddish. Clay is more or less diffusible in water, some of it becoming quite pulpy with it, some of it resists the most violent fire without melting; others melt into a spongy or vitrified mass. Some produce an effervescence with acids, others do not. Some are called boles, that consist of fine, soft particles, and are noted for a particular colour, as red, blue, or yellow. These were formerly in high estimation, from

their medicinal qualities, and were brought from the most distant parts of the world; and as it was easy to imitate these, it was necessary to stamp them with seals, as a proof of their being genuine, so they were called *terra segillatæ*. But we generally find a large admixture of sand in them, and in general all the clays that feel gritty, derive this quality from the sandy, calcarious, or other particles. An easy way to satisfy ourselves of this, and to obtain the clay earth in a purer state, is to mix it with water, to the consistence of milk or cream, when the sand settles to the bottom first, and we can pour off the muddy water containing the clay. This is called *elutriation* in chemistry.

## DLXII.

The variety of colour in clays depends upon iron in most cases, which can be extracted from a great variety of them, especially those that burn red in the fire. There are some mixtures of this kind that are so rich in iron, that they are melted, and the iron extracted with profit. In others the colour is from an inflammable matter, and these are distinguished by burning white, when exposed to heat in a proper manner.

## DLXIII.

From this view of the variety produced among the clays by these admixtures, will be understood whence arises the variety in their qualities; why some effervesce with acids; why most melt, when exposed to a violent heat, as we find the addition of earthy substances to clay disposes it to melt, particularly that the calces of iron have that effect.

## DLXIV.

" The kind of clay which is reckoned the purest, is that employed in the manufacture of tobacco pipes. It is generally of a whitish grey colour; but it is a necessary quality that it acquire a fine white colour, when exposed to a certain degree of heat. It contains but a small quantity of sandy matter; it is smooth and unctuous between the fingers. It does not produce any effervescence with acids; it forms a paste that is ductile in water, and, when dried and burnt, it becomes as complete and hard as flint. At the same time, no degree of heat yet tried is capable of bringing this clay into perfect fusion; it only softens it, makes the paste unite together, and to undergo some approach to fusion. The tobacco pipes are burnt only with a moderate heat, and by increasing the heat, they can be made much harder. If any smoke is admitted to it, it is liable to lose its white colour, and the common way of burning ware is by putting it into earthen vessels called seafer or safeguards. If the flame was admitted to it freely, the ware would turn out black.

## DLXV.

From these properties, clay is useful for forming chemical vessels; but it forms them very compact, and not fit for bearing sudden changes of heat and cold. Sand is therefore added, and a mineral substance called black lead, or talk. It is not easy to say in what manner these additions produce their effect; but when they are added in a certain quantity, the vessels endure these alterations much better.

## DLXVI.

The third division of this class is the flinty earths. Their distinguishing character is their extreme hardness; they scratch glass, and strike fire with the hardest steel; a part of the steel is tore off with such violence as to be heated red hot; and flying through the air, it is blown up into a state of inflammation. This earth is also called crystalline and vitrescent, occurring in the form of regular crystals, and it is the principal ingredient in the better kinds of glass. It is supposed to be purest when it is transparent and colourless, or it has only a whitish or milky transparency, when it is called quartz; but it often occurs in an impure state, when the appearance is various. When it has a horny appearance it is called flint-flint.

## DLXVII.

These are the shapes in which it is supposed to be perfect, but it often occurs impure, and the appearance is various. 1. It is found constituting strata in the sand, gravel, &c. Some sands are perfectly white, and are found to consist of grains of pure quartz. Gravel is much of the same nature with sands, and forms considerable strata mixed with sand. It consists of this matter in large grains and masses, but is seldom pure; it possesses an admixture of other matters. Pebbles are some of these gravel stones, and owe their beauty to the great purity of their materials, and the manner in which they have been found. The external surface is rough and unpromising; but when broken up, they have a different appearance, shewing an exceeding smooth surface, with colours and veins, from an admixture of other earth with the flinty. There is always a central piece, around

which there are a number of layers, which are diversified in all the whitish or milky pebbles. These layers are less transparent. This is particularly the case with regard to the stones of this kind, called agates. In others there is a number of different colours, two or more in the composition of the layer, and which gives a greater variety to the appearance of the stone.

\* DLXVIII.

The variety among these stones is so great, that there is no end in the division of them. Some of them which appear like pebbles, are colourless and transparent within, and are called pebble crystals. In others the colouring matter is diffused through the whole of the stone; they are sometimes of a pale red, like flesh, as the cornelian, &c. Some have ramifications of a dark coloured matter, resembling moss or sea-plants, which has been occasioned by an opaque matter insinuated into cracks in the stone, and branched out into figures, resembling those of the vegetables, as in the mocha stone.

DLXIX.

The free stone employed in building chiefly consists of this flinty earth. It is plainly composed of sand, cemented together by an operation of nature, as appears from the manner in which the different layers separate, the surfaces of which are waved like the sand on the sea shore; so we cannot doubt but that waving has been produced by the action of water, and we meet with the reliëfs of the productions of the sea, as of madrepores, &c. The stones are of very various hardness; in some the particles have little more cohesion than sand, in others the grains are so much compacted as to look like a solid

flint, and they can be wrought like free stone, which requires to be of a moderate degree of hardness, that it may be cut without much difficulty, and at the same time that it may be capable of bearing the attack of the air, without being easily decayed.

## DLXX.

In England, &c. there are strata that contain sand and gravel both cemented together; and in the pudding stone, which is composed of a whitish sand, intermixed with pebbles, so compact is its structure, that it receives a fine polish, and looks like the skin of a spotted animal.

## DLXXI.

The flinty earth is that principal ingredient in the granite, and in the more compound rock called whin, which is a coarser kind of granite, containing a very large quantity of iron. Granite appears to be formed like free stone, and a great many of the grains composing it are of the flinty kind. Upon the whole, therefore, there are not many stony or rocky strata that do not contain more or less of this flinty earth; but besides, it is found in veins filling up perpendicular fissures, and is called quartz, of the colour of milk and water, occurring sometimes more transparent, and sometimes more white, and in it there are innumerable flaws; so the broken surface is always very rough and uneven. It occurs sometimes of a foliated structure, like spar, and breaks in rhomboidal pieces, and is a mixture of spar and quartz.

## DLXXII.

The silcx, or gun flint, is found intermixed with strata of ~~other~~ matter. It is sometimes found in veins, but the



greatest quantity of it is found in the strata of chalk, with which it is intermixed in very various ways, often filling up perpendicular rents; but besides it is interspersed with nodules that are connected together in a horizontal direction. The form of these is quite irregular; sometimes roundish, sometimes oblong, in a manner that is incapable of description.

## DLXXIII.

There is another appearance which often occurs in the strata of lime-stone, and is then called chert. It is met with like flint in chalk, through the lime-stone, and a part of the lime-stone seems to be converted into flinty matter by some operation of nature, and we find the reliëts of marine productions in the middle of it, with which the lime-stones abound. Some of these appearances occur too in the masses of flint in the chalk, which seems to have been penetrated by some matter that has produced this change upon it.

## DLXXIV.

But among the most curious forms in which the flinty earths appear, are the crystals. These are always found in the cavities of the veins, where quartz occurs. They are either columns of six sides, terminating by a pyramid, or they are found separated from the surface of the cavity, and pyramidical at both ends; but more commonly there is not any particular column, but merely a pyramid, still consisting of six sides, and thick set by one another.

## DLXXV.

These crystals vary too in their colour; some are trans-

parent and colourless, as the German crystals; many have a dark opacity, which make them appear quite black till they are broken in many pieces, when they appear transparent, and in many cases the colour can be put away by heat, by exposing the crystal to a fire, or by surrounding it with oil; only, if the heat is too great, cracks and flaws are occasioned. They pass for gems; their hardness is nearly equal to that of the gems, and their colour is fully equal; they have their beauty, receive a fine polish, and wear sufficiently. Some have a beautiful purple colour, and pass for the amethyst; some are of a yellow colour, and then they pass for the topaz, &c.

## DLXXVI.

To the same head may, with propriety, be referred the gems, which are found either in the state of crystals, or pebbles, and seem to be composed of flinty matter, appearing in a much purer state than ordinary; or, perhaps, in consequence of its being improved by the admixture of some other matter. The colour for which many of them are admired has been imputed to metallic substances, and chemists had good reason to suppose this, as they found that the calces of metals can be made to tinge glass with colours resembling these of the gems, but we find that the colour can be expelled by a gentle degree of heat, and this is attended with a luminous vapour around the stone, so that it depends upon a matter that is more subtle than the grosser parts of the metals, as is the case with respect to the colour of the amethyst.

## DLXXVII.

The other form in which flinty earth appears, is as com-

stituting petrefactions; we find masses of vegetable or animal matter penetrated with it, so as to become stinty, still retaining somewhat of their original form. We have many curious examples of this in different parts of the world. And, with regard to its chemical qualities, the most intense heat has never brought it into a state of fluidity. Some of the gems do not undergo any change from a violent heat; but, in general, the gem loses its transparency, and is traversed with innumerable flaws that render it more easily broken in pieces.

## DLXXVIII.

The next division we come to is the fusible earths; they possess this quality not exclusively, but only in the most eminent degree. The character that may be given of them is this:—they bear a great resemblance to the stinty concretions; they are stony hard substances that do not effervesce with acids, but they are not so hard as the stinty; they do not strike fire with steel, nor scratch glass; they shew no great degree of fusibility, although they possess this quality in the highest degree of any of the earthy substances; when reduced to fine powder and mixed with any of the acids, they do not emit volatile acid steams, nor are they by means of a solution of alkaline salts changed to a calcarious earth.

## DLXXIX.

The natural stones which seem to require separate consideration under this title are of five kinds.

The fusible earth is most pure in what is called *flus* by the Germans, or *fluur*. They are like the more transparent quartz; they are commonly tinged with different colours, and have their names from the gems, as *pseudosmaragd-*

ous, &c. They are distinguished by their great degree of fusibility, so that they pervade the crucible in which they are melted; we find this sort of earth in the rhombic quartz, which is composed of flinty matter. Combined with this in different proportions, it is also called fels-par. It is found in the granites; it is composed of angular grains, which in most of the granites are closely compacted, so as to form a hard stone capable of receiving a fine polish; it occurs also in veins; it is a stone less transparent than quartz, commonly having a reddish tinge, or flesh colour; it appears to have a plated structure, and it has a disposition to break into rhomboidal fragments. The first effect of heat is to render it more brittle; if it is increased to a strong degree the stone melts, or becomes pasty, and at the same time the rich colour commonly goes off, and it forms a semi-vitrified mass of very great whiteness; on this account it is one of the best ingredients in porcelain.

## DLXXX.

Another kind of stony matter that contains this earth is the garnet, a transparent stone of a rich red colour like crimson; many of them are of such transparency as to be reckoned among the gems, but the greater number are divided by flaws, and mixed with a coarser matter, so they have not this colour; but when examined in small particles by chemical analysis, they are always crystalized into somewhat of an angular form. It is found to contain some iron, to which is imputed its red colour; some of them hold a quantity of tin, but there are other specimens that contain none of either, and these have less colour, or are of a pale yellowish colour. It is found in separate grains, nodules in rock strata, that are chiefly composed

of talk. There is a considerable tract of this in the north of Scotland, where the little nodules of granate are contained.

## DLXXXI.

Another fossil which has this earth for its basis, is called coral, or cockle. It is a composition of rocky stones in separate grains, or masses, and crystallized into columnar stones; when they are of a black colour, they are called jasper, and are sometimes with shades of green. This fossil abounds in the composition of the stones used for beautifying our streets, which are full of oblong crystallizations of a shining black colour; when exposed to heat it melts without difficulty into a black glass.

## DLXXXII.

The last matter in which this earth is found is in the substance called zeolite. It occurs in nodules in rocky strata, and by its outside resembles the pebbles; when they are broken they often shew a radiated structure, parts of the stone shooting in crystallizations from the centre to the circumference of a sphere: sometimes, when broken, they are found hollow within, and beset with crystallizations.

## DLXXXIII.

The next and last division of this class comprehends the flexible earths. These earths and stony concretions which, when pure, are flexible, do not effervesce with acids; they do not imbibe water like the clays, nor are they so hard as the stony ones; in an extremely violent heat they shew a degree of fusibility. They have been divided

into the mica and asbestine, or into the talks, or asbestus.

## DLXXXIV.

The talks are foliaceous stones, slippery between the fingers, sometimes colourless and transparent, as the proper Muscovy talk. It has great transparency, flexibility, and elasticity, and is divisible into incomparably thin plates; but more commonly it is coloured; sometimes of a dark, dusty colour, and the plates are seldom so small, or so much in a plain, but waved: sometimes it has a greenish-hue, sometimes a yellowish brightness, resembling that of gold, and these colours have imposed upon persons, and made them imagine they had found gold or silver, though the talk does not contain the smallest quantity of either; the yellow colour is from iron, and the silver appearance, from the particular disposition of the plates, for when they are transparent, the plates are a little separated; by heat they acquire the same silvery colour; sometimes in talk it is found forming a powdery, or earthy substance, consisting of minute small scales that are slippery, and adhesive to the fingers, giving them a colour like that of the metals. In such specimens the earth is mixed with a large proportion of metallic substances. Sometimes it occurs in a black colour, and has a shining appearance resembling that of polished steel, and abounds with iron, and it has not the flexibility of the earth in its pure state. The talk is found plentifully in the composition of many rocky strata in the granite, and other such strata as are flexible, and in rocks which contain garnets; in the stone called lapis clares, which is composed of the stealites mixed with talk, and it has a quantity of magnesian earth in its composition, and is use-

ful for kitchen utensils that stand the fire. There is, too, a considerable portion of white talk in the composition of clays and of gravel, which is all from the rubbish of some rocky masses in which talk is originally formed.

## DLXXXV.

The asbestus and ameanthus differ chiefly in their structure from the talk, in the flexibility of the fibres, and in the closeness and looseness of their texture. These are reckoned the most pure and perfect, that may be teased out like cotton, and can be made into a web that suffers no harm in the fire. Pieces have been taken out of ancient Roman urns, which were used to wrap the bodies that were burnt, to preserve their ashes separate; others have attempted to make a sort of incombustible paper with it, but we cannot contrive any gelatinous matter to unite it, that will withstand the fire.

## DLXXXVI.

Besides the asbestus, properly so called, there is a fossil of the same nature that is formed into membranes like leather, or into masses like flesh, or like cork, and has the names of mountain leather, mountain flesh, and mountain cork.

The asbestus varies much in point of the fineness of its fibres and its flexibility. In Scotland we have some specimens that have some degree of flexibility, but we have it in a state in which it has little, or none; in some, the fibres are fine, and parallel to one another, and when teased out, are like silk, or cotton; in others, the fibres are so compacted as to form a hard stone; but even these hard stones, when long exposed to the weather, become soft like wax.

Such are, therefore, the principal specimens and varieties of the earthy substances, &c. Before dismissing them, we shall enumerate the different kinds of gems; but this title does not contain any class of stones that agree in containing any particular earthy matter, but any stone that has some colour, brightness, and smoothness, which please people's fancy, or taste, is so called. These may be divided into the precious stones and gems, into the marbles, jaspers, porphery, stone granate, and pudding stone. Of the gems some are pellucid, others semi pellucid.

## DLXXXVII.

The marbles are calcarious earths; they may be used as such for lime-stone: some of them are valued in consequence of their being of an uniform colour, as the white and black marble; but the greater number is variegated, and these variations depend upon two circumstances, either upon the reliet of shells appearing still in the marble, giving it a diversity of colour, or upon the calcarious stone having been shivered into pieces, and the interstices filled up with other matter.

## DLXXXVIII.

With regard to the jaspers, this name is applied two ways; the artists make one application, and the naturalists another. The first apply it to any hard stone that is capable of a fine polish, and is diversified with a variety of colours which are brighter than those in any of the marbles, and at the same time they contain a harder matter; often a quantity of flint intermixed. It is, in reality, a marble, though there is here and there a mass of flinty matter intermixed, as occurs in all calcarious stones, only the co-



lours are much brighter, with a large admixture of red, yellow, and white.

In natural history the term jasper is applied to flinty stones that are coloured with iron, and the most noted of this kind is of a rich and deep green colour with red spots, as the *heleotropium*, in which the whole colour proceeds from iron. There are a great many other stones of this kind; most of them are of a reddish colour, as the *lapis lazuli*, which has been shewn to be tinged with iron, and not with copper.

## DLXXXIX.

The porphery resembles marble, but is harder; it is of a chocolate colour, with white spots intermixed; there are many specimens of it in Italy; probably brought over from Egypt.

## DXC.

The granate has the felt spat, or rhombic quartz for its basis, with a quantity of talk, so united as to form a hard stone ~~which is the point~~, and is valued on account of the variety in the reflexion of light that it gives, and for the different colours of the felt-spat.

The pudding-stone consists of sand and pebbles cemented together, forming a hard substance that receives a fine polish, and with spots like the skins of spotted animals.

## DXCI.

These earths that have been considered as gems, are the pebbles, which are semi-pellucid, the agate, onyx, opal, chalcedony, cornelian, and mocha stone.

## DXCII.

The agate has a whitish, or milky, appearance, with a more transparent flinty substance, and the milky appearance is diffused in clouds. In the onyx this substance is arranged in layers that are parallel.

## DXCIII.

In the chalcedony there is a whiteness in an unequal manner. In the cornelian there is a reddish tinge, resembling the colour of flesh; and the mocha stone is an agate, with ramifications of a brown metallic matter, spread like the branches of a tree.

## DXCIV.

The pellucid gems comprehend the flinty crystals; Bristol stone, German stone, &c. which are so transparent as to look very bright: the granate of a rich crimson colour; the amethyst tinged of a beautiful purple; the topaz, yellow; the sapphire of a fine blue; the emerald, green. The diamond is the most valuable, and at the same time the most remarkable for some late discoveries, with regard to its chemical qualities. It is distinguished also by its great hardness, far beyond that of any other stony substance; and this has inclined us to suppose, that it is composed of a more pure earthy substance. But it is not a pure earthy substance, for it is altered and improved by some addition of a subtile principle, that renders the whole a volatile mass; for late experiments shew that it is very far from being a very fixed substance; so that it does not agree with the other earthy substances. In general, when it is exposed to any very excessive heat, it evaporates with a luminous vapour, or manifest flame; and other cir-

cumstances of the experiment have shewn that it undergoes actually a sort of inflammation; for unless the air be admitted, it does not undergo any change when it is put into a close vessel, with powdered charcoal; it withstands any heat without the least change; so it is only when exposed to the air and heat at the same time, that it is disposed to evaporate and burn away, till a very small quantity only remains behind; the nature of it, therefore, is very singular and well worthy of further investigation.

Having finished the history of the earthy substances, it remains to mention the consequence of violent heat upon them, and of mixing them with one another, and with some other bodies under the action of a violent heat. These deserve our attention, as from them has arisen the elegant art of making porcelain, or the finer kinds of pottery.

#### DXCV.

##### *Porcelain.*

Mr. Pott, of Berlin, has made a variety of experiments upon the different kinds of earth; into which he was led by a desire of discovering the compound of the true porcelain, which he published in his *Lithageonofia*. They are so diversified, that a general view of them can only be given. He mixed them with salts, with some of the metallic calces, and with one another, and exposed them to the most violent heat he could command, by means of fuel in a furnace constructed for that purpose. The general result with regard to the earths of the purer kind is, that they all turned out difficult of fusion, or rather perfectly unfusible; but later experiments have shewn, that there are several of the purer earths that are capable of a very perfect fusion, and his furnace seems not to have been con-

fructed upon the best principles, that the vent was too narrow.

## DXCVI.

Most of the talky class, and all the classes called fusible, though requiring a very violent heat, are fusible by themselves: gypsum, too, is fusible, on account of the saline matter it contains.

But though he imagined them infusible in their separate state, he found them all fusible by means of proper additions; the most powerful substance for this purpose was fixed alkali, borax, and the calces of some of the metals, or a certain quantity of the fixed alkali added to the stinty earth in powder, brought it into a state of fusion, and a little more of it added makes it very transparent: the absorbent earths, the gypsum, the steatites and clay are easily brought into fusion, by means of borax; the calces of the metals of iron, and more especially of lead, proved a solvent of all the earthy substances, except the absorbent, though the lead in its metallic form has not the power of dissolving the earthy bodies. Upon examining the earths, he found that the calcarious and absorbent earths proved a means of bringing the stinty and argillaceous earths into fusion; the calcarious earths, or gypsum, or, still more readily, the fluor spatosus, which contains the calcarious earth with the spar, proves powerful in bringing these parts into fusion, and these mixed together in certain proportions, produce mixtures that have still more power, and are capable of melting large proportions of other matters. We find some of these so fusible as to dissolve the bottom of the crucible. The knowledge of these particulars is necessary in extracting the metals

from their ores, for some of them are intermixed with such a quantity of earthy and stony substances, that it is difficult to separate them.

## DXCVII.

Elutriation is used for that purpose ; the whole matter is pounded and set in motion in water, to set the lighter parts afloat, and the metallic part remains behind ; but in some cases they are so blended that they cannot be separated without great loss ; the only expedient is to melt the whole, when the metallic matter settles to the bottom, and the earthy bodies float above, forming a glassy fluid that is incapable of mixing with the metals in their metallic state. But there are many of the earthy matters thus blended which can hardly be melted ; and the metallurgists had been in the practice of mixing earthy and stony substances together, brought from distant parts, to obtain compounds of easy fusibility. These compounds they had discovered, and Mr. Pott has experienced the nature of them, that the materials are always of the calcareous kind, and these, when added to the flinty matter, or quartz, the attendant of ores, greatly promote their fusibility.

Mr. Pott has pointed out these advantages that has resulted from his experiments, but he is silent upon the subject of porcelain ; and all the information we have of this subject is from other quarters.

## DXCVIII.

The porcelain brought from China and Japan has been long admired on account of its beauty, but it was

more admired than any hopes formed of our being able to imitate it. We attempted some which had a considerable share of beauty, but it was inferior to the true porcelain. Clay is the foundation of these arts, on account of its plastic nature, and the degree of hardness and firmness it can be made to assume; but it forms vessels that have neither beauty, that never burn very white, and which are apt to break and divide when suddenly heated. The addition that was found best to give them beauty was a large proportion of flinty matter, and this is the composition of the stone ware. To this, besides its strength and durability, and considerable share of whiteness, the manufacturers discovered an easy way of giving it a sort of glaze, to render it very durable; this was put upon it by throwing it into the furnace, when the heat was raised to the highest degree, viz. a quantity of common salt, the steams of which diffusing themselves through the whole cavity, penetrates all the cases in which the ware is contained, and applying themselves to the surface of the ware, brings a small portion of it into a state of fusion, so as to produce a glazing upon the outside, but still there is a number of little pits left which the matter had not covered, and which gave a lodgment for foulness and dirt, that could never be taken out again. Of late this sort of ware has been improved, in some degree, by a sort of glazing, which takes away all these inequalities, though it does not give a colour to be compared to that of porcelain. It is a composition of materials that serve to make glass, mixed up in a thin fluid of the consistence of cream, and laid upon the surface of the ware; and this, by means of a new heat, is

diffused over the ware, and gives it always more or less of a greenish or yellow colour, which is not disagreeable, as it is diffused uniformly over the surface, though the other had this advantage, that one fire served to melt the glazing and bake the ware.

## DXCIX.

But still the most perfect ware of this kind is far inferior to the China or Japan porcelain, with respect to its dilute and durable glazing, and the lively colours it is capable of receiving on account of the whiteness of its ground. Some imperfect attempts have been made in Europe very early to imitate this porcelain, but they were very imperfect till we came to receive some accounts of its manufacture from some of the Jesuits' missionaries.

## DC.

These different publications have engaged a great number of persons in the pursuit of this art; and the consequence is, that they have made a great many discoveries with regard to it, and have put in practice many different ways of making ware that more or less resembles it. The greatest number have gone upon Reaumeur's principles, making use of glass for their cementing ingredients, that such compositions deserve only the name of false porcelain; they are attended with many imperfections; the difficulty of giving them the proper degree of fire: wherever glass enters it must be heated to a certain degree, to make this matter cement the other materials to a certain degree of closeness: thus the pieces lose their form and become perfectly fluid, so as to collapse in

the cases in which they were burnt ; it is also very nice in these large furnaces to give the same degree of heat, but some of the ware gets too little and others too much heat, and thus a great part of the labour of the workmen may be lost. But though they succeed, the ware is attended with imperfections : it does not bear sudden alterations of heat and cold like the true porcelain. It is certain, however, that in many different places, the proper ingredients have been discovered, and they have produced a porcelain fully equal to the Chinese. The first of these manufactures was established in Saxony, which has been long famous for its beauty, and the expence bestowed on its decorations ; but it is as remarkable for the goodness of its materials, having all the qualities of the best china porcelain ; the structure is somewhat different, owing to a little more pains in the manufacture. When a piece of it is broken the surface of it is much finer and closer, from the more perfect mixture of the materials.

Some discoveries were made in France, which led to the principles upon which the true porcelain is made ; and specimens have been presented to the academy that have all the qualities of the foreign porcelain. In England, though several manufactures have been established upon wrong principles, it is certain that there are some, at present going on, that produce porcelain of the very best quality.

#### DCI.

The ingredients are now perfectly known ; and the principal and most important materials are, that matter the Chinese call *petunse*, and the ingredient most necessary in its composition is the felt spat, or rhombic quartz.



This substance, exposed to a certain degree of heat, becomes more brittle, and when calcined to a certain degree, it is easily reducible to a fine powder which, in a violent heat, undergoes a perfect fusion like glass; at the same time any colour that it had before entirely flies off, and it acquires a beautiful whiteness. This matter mixed in a certain proportion with a very pure clay, especially containing a considerable proportion of white mica, or talk, forms the finest porcelain, and enables it to endure a violent heat without fusion, while the other substances give it the compactness of texture, and semi-transparency that is admired in this ware.

## DCII.

Still, however, the art is very difficult, for the materials for producing it are very rare: the felt spat is by no means a rare substance, but it is generally in the composition of the granite, which contains several other ingredients. It is composed of felt spat, quartz, and talk, and often a quantity of iron, and the smallest proportion of the metal spoils the whiteness of the matter, so it is difficult to find materials of proper purity; and the only circumstance that has given the Chinese such advantage over us, and established this manufacture among them so very early, is the plenty they have of such materials; these materials, however, have been found. The Saxon porcelain, no doubt, depends upon a discovery of this kind; and the French chemists understand this so well, that the specimens of good porcelain, produced in France, must have gone upon the same principles.

## DCIII.

In Cornwall they have met with materials for the pur-

pose, and a manufacture is established there that is likely to prove a very thriving one ; the granite abounds there, and consists chiefly of fels par and rhombic quartz, with white talk, which has been found an advantage, and they find a clay that answers the description of the Chinese kaolin, which is of great whiteness, forms a tough and ductile paste, and has besides another quality of the Chinese kaolin ; it is very full of white talky particles, which undergo some change similar to that of the petuntse, so it does no harm in the composition of porcelain. This clay is a product of the same stone with the petuntse, which, by exposure to the air, has undergone a sort of decomposition, and lost the principle upon which its flexibility depends ; and this matter, after it has been gradually washed off by the rain, is carried down by the water, and deposited in particular places. When it is exposed to a violent heat by itself, it bakes into a very hard substance, which has the grain of porcelain, but wants the transparency, and is called stone china, and it resembles some of the Japan china, which is admired on account of its beautiful glazing and bright colour, while the Chinese porcelain, from an admixture, is, in some measure, transparent.

## DCIV.

By Reaumeur's discoveries, glass has been reduced to a sort of porcelain, by taking away part of its vitrifying ingredient, the alkaline salt ; and he got it in several respects to answer the very best porcelain : so this might be a useful art in making chemical vessels ; but no person has ever found his advantage in the establishment of it.

## DCV.

The division of earths now exhibited is chiefly as they are presented in nature, or in a compound state. This division, therefore, is incompatible with the views of chemistry, which endeavours to ascertain, with precision, their radical principles, and on those principles alone to arrange them.

## DCVI.

According to the description of this class formerly given, (VIII.) every earth is to be considered as an inodorous, dry, hard, brittle, inflammable body, naturally white, and generally tasteless: corresponding to this definition, earths have been arranged into no less than 10 radical species.

## DCVII.

The first of them is lime, which when freed by strong heat from extraneous matters, is white, moderately hard and brittle, and its specific gravity 2.3. It yields a hot, burning taste, is caustic to animal substances, and changes the syrup of violets green. It is not fused by the most intense heat.

## DCVIII.

Lime is soluble in water but in small proportion, as in a temperature of 60 it dissolves only  $\frac{1}{200}$  part of its weight; but at a heat of 212, it dissolves double the quantity; it combines with all the acids, and in consequence of this, various productions arise.

Sulphat of lime selenite, or gypsum, is found abundant in nature; it is of a white colour, and, by fire, is reduced to plaster of Paris. It possesses a strong attraction for

water, which it greedily absorbs, and in this state forms mortar. It consists of 32 parts of lime, 46 of acid, and 22 of water.

Nitrat of lime very much accompanies nitrat of potash. It is of a sharp bitter taste, is soluble in 8 parts of cold water, and has double its weight, at least. It contains 22 parts of lime, 43 of acid, and 35 of water. After being heated, it shines with a phosphoric light in the dark.

Muriat of lime abounds in nature along with muriat of soda, and its presence gives a bitter taste to sea water. To make it pure, muriatic acid should be clearly saturated with lime. It is soluble in  $1\frac{1}{2}$  parts of cold water, and in equal parts of hot water, or 212. Its proportions are 44 parts of lime, 31 of acid, and 25 of water.

Borate of lime is insoluble in water; it cuts glass, and strikes fire with flint; in other respects it is little known.

The fluat of lime, or fleur spat, is abundantly dispersed throughout the mineral kingdom; it is of a compact sparry texture, is very insoluble in water, and phosphorescent with a moderate heat. Its proportions are 57 parts of lime, 16 of acid, and 27 of water.

Carbonate of lime, or mild calcareous earth, exists in the different species already noticed of chalk, marble, limestone, calcareous spar, stactalite, &c. Its proportions are 55 parts of lime, 34 of acid, and 11 of water. By heat the acid is disengaged, pure lime remains, which by exposure to the air, moulders down, but again recovers its hardness, by a new absorption of carbonic acid.

Phosphate of lime is only soluble when the salt is in excess. Its proportions are 55 parts of lime to 45 of

phosphoric acid. It forms the basis of the bones and hard parts of animals.

Sulphuret of lime. Lime combines with sulphur, either by fusion, or by boiling them in water; and a sulphuret thus formed differs nothing from that with the alkalies.

Phosphuret of lime is also found by a similar combination with phosphorus.

### DCIX.

The 2d species into which the earths have been arranged, is magnesia. When pure, it is very light and white, in the form of a spongy powder, and it changes syrup of violets slightly green; its taste is also slightly bitter, and its specific gravity 2.330. The combinations of magnesia are numerous, with the acids.

### DCX.

Sulphat of magnesia is found native, but chiefly in mineral waters; it is then termed Epsom salts: but is usually prepared, at present, from the liquor remaining after the extraction of muriat of soda from sea water. The proportions are 24 parts of acid, 19 of magnesia, and 57 of water.

Nitrat of magnesia is found in nitre beds, along with other neutral salts; but it may be prepared by the direct combination of its principles: its crystals are of a sharp bitter taste; it is deliquescent and soluble in its weight of cold water, and in half its weight of hot. Its proportions are 22 parts of magnesia, 46 of acid, and 22 of water.

Muriat of magnesia is found in sea water, salt springs, and in mineral waters; it possesses a bitter nauseous taste, and is very soluble in water. In its dry state, its propor-

tions consist of 310.7 of earth, 34.59 acid, and 34.34 water.

Fluat and borat of magnesia are scarcely known, and applied to no use.

Carbonate of magnesia is prepared by mixing equal weights of sulphat of magnesia and carbonat of potash, by dissolving these salts in twice their weight of water. By boiling this solution, the carbonat of magnesia is precipitated in the form of a light white powder, which is afterward dried by a gentle heat, being white, insipid, and possessing a specific gravity not more than 23.3. It is only soluble in water, in the proportion of several grains to an ounce. Its proportions are of magnesia 0.40, of acid 0.48, of water 0.12. By calcination this salt loses its water and acid, becoming pure, or calcined magnesia.

Sulphuret of magnesia is formed by digesting equal parts of sulphur and magnesia in water; it is decomposed both by acids and alkalis, and does not unite with phosphorus or carbon.

Phosphat of magnesia is a combination little known; it is difficult of solution, and is only rendered so by an excess of acid.

### DCXI.

The third division of earths is into alumen, or argil, being the base of argillaceous earth, or common clay; it is perfectly white, insipid, and light; is smooth, of an unctuous feel, and adheres to the tongue; it is diffusible in water, but not more soluble than magnesia. Its specific gravity is about 23; it combines with all the acids. The first of its combinations is sulphat of argil, or the common alum of commerce; though native, it is more commonly

produced by art, or the direct combination of its principles. Applied to the tongue, this salt gives a taste, at first sweetish, but afterward strongly astringent. It possesses frequently an excess of acid, as appears by reddening blue paper. It is soluble in 15 parts of cold, and 2 parts of boiling water. Its proportions are 38 parts of acid, 18 of earth, and 44 of water. This salt is remarkable for forming the pyrophorus of Homberg; it is made by mixing intimately 5 parts of burnt allum and 1 of charcoal, or by melting together over a fire, till it becomes blackish, 3 parts of allum, and 1 of sugar, of honey, or of flour, which is put in an earthen bottle about two-thirds full, and kept in a red heat surrounded with sand in a crucible, so long as a blue flame is perceived at the mouth of the bottle. It then forms pyrophorus, and burns on exposure to moisture.

Nitrat of argil possesses an astringent taste, and is deliquescent: by strong heat its acid is expelled and decomposed.

Muriat of alumen possesses a styptic saline taste; it first reddens syrup of violets, and converts the colour to a green. It is decomposable by lime water, alkalis, and magnesia; its other properties are unknown.

The borat and fluat of alumen have neither yet been particularly examined.

Carbonat of alumen is also but little known; it has been found native in some places, but it varies in its proportions.

Besides these compounds, argil has the property of combining with the fixed alkalis, and also with lime and siliceous earth.

## DCXII.

The fourth species of earth, silica, exists in the form of a light white powder, insipid, rough and harsh to the feel, and soluble in small quantity in water, but not acted on by any of the acids but the fluoric, unless in fusion, when it combines with two, the boracic and phosphoric. Its principal combinations are with the fixed alkalies, and with them it forms glass; it is also found in waters in a state of solution.

## DCXIII.

The fifth division of earths is baryt, or ponderous earth, so termed from its specific gravity. When found pure it is more caustic than lime, and absorbs water, eagerly forming a tenacious cement. Its solution in water takes place with a hissing noise. Cold water dissolves  $\frac{1}{5}$  of its weight, and boiling water  $\frac{1}{2}$ . This earth is considered as dreadfully poisonous.

Sulphate of baryt is less soluble than sulphate of lime. It is known under the name of the Bolognian stone, and, when heated, it forms the Bolognian phosphorus. The proportions of this salt are 30 parts of acid, 67 of baryt, and 3 of water.

Nitrate of baryt is not found native. It is difficultly soluble in water. To alcohol it gives the property of burning with a whitish yellow flame. It possesses a pungent caustic taste. Its proportions are 57 parts of earth, 32 of acid, and 11 of water.

Muriate of baryt does not exist native. It is prepared by adding muriatic acid to the product of the decomposition of the sulphat of charcoal, or carbonat of potash, or soda. Its solution is filtered, and by evaporation crystal



lized. It is soluble in 6 parts of cold, or in less boiling, water. Its solution possesses a harsh styptic taste. Its proportions are 64 parts of earth, 20 of acid, and 16 of water.

Carbonate of baryt has no taste, is not altered by the air, and is almost insoluble in water. Its proportions are, o 86 pure baryt, o.20 acid.

The combinations of Baryt with the other acids are of little importance, as they are applied to no use

Baryt also combines with sulphur, phosphorus, and several of the earths; but their combinations, as yet, claim little attention.

#### DCXIV.

The sixth division of earths, or strontia, has not been found pure, but in combination with the carbonic acid. In many respects it resembles baryt, but in others it differs. It possesses a sharp caustic taste. It is soluble in 100 parts of cold water, but in less of hot, and its solution crystallizes, changing the colour of vegetables to a green.

The different combinations of strontia it is needless to enumerate, as they have not been applied to any particular use.

#### DCXV.

The seventh division of earth, jargonia, or zircon, is found in a gem brought from the island of Ceylon. When obtained pure, it is in the form of a white powder, rough to the touch, and insipid, having a specific gravity equal to 4.300. It is insoluble in water, forming a gelatinous mass, that becomes hard and seems transparent. By an intense heat it is vitrified, and with borax forms a transparent colourless glass. It combines with the acids, and the alkalies decompose its salts.

## DCXVI.

The eighth species of earth is glucine, discovered in the beryl and the emerald. It is white, light, soft to the touch, insipid, and adheres to the tongue. It is insoluble in water, and is by itself infusible in fire. It is soluble in the acids, and the combinations it forms possess all a sweetish taste, from which it derives its name, and which distinguishes it from every other earth.

## DCXVII.

The ninth species of earth is Ytria, discovered in a fossil, named Ytterby. It is white, smooth, and insipid, infusible alone, but vitrifies with borax. It combines with the acids, and its compounds have not the taste of those which are with glucine. It has been considered, from its other qualities, as the link that connects the earths and metals.

## DCXVIII.

The last species of earth is Agustine, discovered in the Saxon beryl. It is white and insipid; when moistened with water, it is somewhat ductile, but is not soluble in it. By a strong heat it becomes extremely hard. It combines with the acids, forming salts void of taste; from which it derives its name.

## DCXIX.

The earths are a class of bodies not so extensive in their use in medicine as the alkalies, but they are pretty much of the same nature in their leading qualities, and with the acids they form also various compounds; of these compounds one in particular forms the base of the osseous parts of the animal system, phosphate of lime, or the combination of calcareous earth with phosphoric acid. It is

to this combination, the solidity and firmness of the hard parts of the system, and by it the memorial of the animal body is continued after every other part is destroyed and annihilated. A deficiency in the quantity of this combination carried to the osseous parts, constitutes a disease known under the name of rickets, or *malitiae ossium*; and though chiefly appearing in childhood, or the early stage of life, it has also, at times, manifested itself at a later period. A desire for substances of this class is often implanted as an instinct of nature in certain affections of the stomach, or *primæ viæ*, where a superabundant, or disengaged acid prevails. Thus a strong inclination for the use of the absorbent earths, we find manifested in pregnancy, in chlorosis, and also in worms, and some other complaints of infancy; but a very formidable species of this inclination is that which prevails among the negroes, termed the earth disease, which is carried to that excess as to clog intirely the organs of digestion, and to terminate existence. This disease does not proceed, as sometimes imagined, from an inclination to destroy themselves, but is the effect of a morbid state of the system, and particularly of the stomach, which has not been accurately investigated. The earth employed by them is a particular species, which they would not select in this manner were self-destruction their aim, as any earth in quantity would have a similar effect: but from the use of this particular earth they find a peculiar gratification, or relief, from the uneasy state, which excites the desire for it, and by this gratification they are tempted to exceed all bounds in indulging it. This seems confirmed by the accounts of a late traveller, to Mr. Fourcroy, who informs us, that the Otamaquas when the Oronoquo is high, and they can get

no crocodiles (their usual food), live for three months in the year on a fat earth, or clay, of which some of them devour a pound and a half daily. It is a pure earth, and they only prepare it by burning and moultening it. He further adds, they are robust and healthy.

## DCXX.

The sulphate of lime has not been applied to any use in medicine, neither has the nitrate, though alledged to possess strong solvent powers.

The muriate is a remedy strongly recommended in scrophulous cases by some German physicians, and also successfully used in this country of late: it has excited the attention of Dr. Bedoes, and was also formerly much praised, from its apparent sensible qualities, by Fourcroy. The result of Dr. Bedoes's experience has confirmed these favourable presages of its qualities; and there is no case of scrophula in which he has not found it successful. Even after apparent hectic symptoms have taken place. Menstrueric, and every formidable appearance, has speedily yielded to its exhibition, and it exerts the powers of a highly tonic remedy on the constitution. Its effects on the bowels also are not considerable, and it is often necessary to use aperient remedies during a course of it. Hence it is not by any evacuation that its effects are produced.

## DCXXI.

Carbonate of lime in the form of chalk is much used as an alkaline absorbent in the diseases of children, particularly in cases of *dærrhœa*, from an acid cause. In most cases also of colliquative diarrhœa, where the stomach is apt to allow the food, from imperfect digestion, to pass

into an acid fermentation, it is usefully combined with other remedies: as an external application it is also proposed in certain cases of ulcers, particularly where there is much fetidous discharge, and relaxation, without a vitiated habit producing the morbid state.

## DCXXII.

The second of the earths, or magnesia, is more generally employed in medicine than the former. Its qualities are, in its pure state, that of a simple absorbent; and, from its effects in this way, it is much used in all complaints where a disengaged acid is present in the primæ viæ. These complaints are particularly frequent in childhood; in the female sex, under pregnancy; and in most cases of dyspeptic patients; so that magnesia forms a medicine of general application. It is oftener used in the form of the carbonate than in the pure state; but this should never be admitted, where used as an absorbent, particularly in dyspepsia.

## DCXXIII.

The preference given to sulphate of magnesia, or Epsom salts, as a purgative, depends on its great solubility.

Nitrate of magnesia has never been employed in medicine, but its sensible qualities give indications of its possessing highly active powers, which might be exerted successfully in the animal œconomy. The same observation may be made on the muriate.

## DCXXIV.

The third of the earths is alumine; and the sulphate of alumine has been much used as a powerful medicine of the astringent kind. Hence it is employed in all cases of passive discharges, and often with most certain success. As a

tonic it is also occasionally had recourse to in intermittents, after the bark has failed. It is particularly used externally in solution in inflammations of the eyes, and in other cases where the inflammatory state is kept up by relaxation. When given internally in a large dose it proves laxative, and is frequently useful with this intention in cholera. The other combinations of alumine are not employed in medicine, and but little known.

## DCXXV.

The fourth division of earth, or the siliceous, affords no preparations in medicine: and of the baryte, the next division, only one compound is employed, the muriate: this medicine is recommended as of very powerful efficacy in cancerous and scrophulous affections, and the enthusiasm that attended its introduction, by extending its praises too far, lessened the real merit to which it is justly entitled as an active medicine. Every one will readily allow, who has tried it, that it may be given with great advantage in certain cases of ulcerations, particularly in those of a venereal origin, where mercury has preceded without its effecting a cure, or where the constitution is so far weakened, that the specific cannot immediately be entered upon. In these situations the muriated barytes will be found to amend the health, to strengthen the constitution, and to dispose the ulcerations to heal: but, at the same time, though it is thus a medicine of promising success, it is often rendered uncertain, by being improperly prepared. From its nauseating effect also on the stomach it is, at times, a medicine not agreeable to the patient, and with the irritable and nervous it is apt to occasion deliquia and other troublesome symptoms. It is, therefore, a

preparation on which no great confidence can be placed for a permanent cure of any disease, though it will produce, at times, a most favourable commencement of amendment. The cause of this we must seek for in the state of the animal fluids, and were we acquainted sufficiently with the proportions of the compound salts exsisting in them, we should then be able to regulate the exhibition of the barytes and every other saline remedy, in such a manner as to procure, instead of temporary relief, a certain and permanent removal of the morbid state, by clearly understanding its cause.

## DCXXVI.

This subject of the combination of the alkaline earths with different acids, as medicines, deserves much attention: we find that even substances apparently agreeing in their simple state, differ materially in their combinations. Thus the baryt and strontia much resemble each other: the combinations of the former are dangerous to the animal frame, and often prove highly deleterious, while the compounds of strontia may be safely tried, and do not appear to possess any quality injurious.

## DCXXVII.

On the whole, the earths, as medicines, are very circumscribed in their application, and it is only these that have received the appellation of the saline terrestrial substances that have been introduced for this purpose.

## DCXXVIII.

The first of the earths, or lime, has been esteemed as a powerful lithontriptic; and lime water, in this view, has employed the pens of the first writers.

It gave occasion to a dispute between two professors of Edinburgh, Dr. Alstone and Dr. Whyte. The former alledged, that the water made from the lime of shell-fish was better than any other; and gave directions to add 10 or 12 times its weight of water to the lime; and when we want to make it very strong, to pour the water several times upon the same proportion of fresh lime. Dr. Alstone again maintained, that the lime of shell-fish was not better than the other more common kind; and that, if it was properly prepared, and the lime agitated through the liquor, it would, at first, be made as strong as it was possible to make it, and that much less lime than he directed, was sufficient for the purpose, the lime containing a much greater proportion of soluble matter than he imagined; so that it was unnecessary to pour the lime-water repeatedly upon fresh lime, as the lime first added contained more soluble matter than the water could receive.

The quantity of the limy matter which the water contains is very small; whatever pains we take to saturate it, not above 1 gr. in the ounce, or 16 grs. in the pound.

The combination of lime and alkalies shows a high degree of acrimony, with regard to animal and vegetable substances; applied to the softer parts of animal substances it very quickly dissolves them; and applied to any part of a living animal, it destroys the part with an intense burning pain, similar to that produced by a burning coal: so it is used for making ulcers, or issues, in the skin, and is called the potential cautery, or causticum commune, and it is not to be taken internally, unless diluted.



Sulphate of magnesia, or Epsom salt, already noticed, has been long in use in medicine, under the name of the bitter purging salt. It was first obtained from the mineral purging waters at Epsom, and sold at a high price, from the small quantity obtained from the Epsom waters; but it was found to exist in all salt waters, in the Littern, and was prepared at Lymington, in Hampshire, and exported to Germany, where it was much valued, still retaining the name of Epsom salt. It consists of dry small crystals, bearing some resemblance to those of Glauber's salt, but they are more bitter and disagreeable; they contain a large quantity of water, and undergo the watery fusion. Yet they differ in being a composition of an acid with an earth, instead of an alkali in the solution, the liquor becomes turbid, and deposits a white earth, which is what we are now speaking of. This being crystallized with more care, evaporated moderately, and set by in a large quantity; it forms crystals of a large size, which bear a great resemblance to those of Glauber's salt: so that great quantities of it are sold under this name; and the fraud is less liable to be detected, as the qualities of both in medicine seem to be nearly the same, it being rather more efficacious as a purgative; only it is liable to act with a little more violence and griping, and its taste is more disagreeable. It is very easy to distinguish this fraud; to detect it: the look of it is considerably different, Glauber's salt is still more of a whitish colour, and has not that watery, or icy transparency, which the other has: but we need only dissolve a single crystal, and apply a solution of alkaline salt; if it is Glauber salt it will remain transparent, but if it is Epsom salt it will remain muddy.

## DCXXX.

CLASS V. *Metals.*

The metals are a class of substances that have attracted attention in all parts of the world by their lustre, and are valued as materials by which we can execute innumerable purposes of the greatest importance in life; for,

1. In consequence of their fusibility and malleability, we are enabled to give them any form our purpose requires.

2. From their strong cohesion of parts, they are the proper materials for machinery of great strength and long duration.

3. The different degrees of hardness and elasticity they possess, or can be made to assume, render them useful in many utensils. And,

4. The compactness of their texture renders them useful for the construction of a variety of vessels; many of them bearing sudden alterations of heat and cold without injury. Besides this, their lustre and brightness make them useful in many of the ornamental arts.

## DCXXXI.

They have been much more the object of attention than any of the other classes of bodies, but much less advantage has been derived from the labours bestowed upon them, than might have been expected, for the greatest number of experiments have been made by visionary projects of the alchemists, whose sole aim was to convert the cheaper metals into gold and silver; hence, the greatest number of these men thus employed had little education, and were ignorant of any chemical principles, so that they

were for the most part incapable of making judicious experiments, or of understanding them when properly made; hence, they speak with the greatest pomp and admiration of the most trifling things, when, in reality, they had discovered nothing. They were, no doubt, led to the knowledge of many curious facts, but these they have concealed, or, if they have told them, it is in such mysterious and ambiguous language, that it is disagreeable to read their works. Without then entering into the fruitless toil of searching their facts, or of detecting their falsehoods, we shall consider the nature of metals, as they may be seen and judged of, and begin with an account of their more general qualities.

## DCXXXII.

The most obvious general quality of metals is their remarkable weight, in which they exceed all other matter. By this, they are distinguished in their natural state from the stony bodies, some of which approach, in some degree, to the density of metals, but they always fall short: the heaviest stony bodies only exceed the density, or weight of water, in the proportion of 4 to 1. But tin, which is the lightest of the metals, is in proportion of 7 to 1; so they are the densest of all bodies, judging them from their specific gravity. They are remarkable for a great degree of opacity, or power of reflecting the light from their surface, without allowing any remarkable quantity to enter their substance: all are, indeed, not perfectly opaque bodies, for we have the experience of the contrary: when they are beat into thin films, they transmit a quantity of light, but they may be reduced to a thinness surpassing that of any other matter, and yet the

light transmitted is very small; so they are the most opaque of all bodies.

DCXXXIII.

Metals hold the first rank among the non-electrics; the first of them very easily become electrified, by being rubbed properly, and they afterwards communicate it to other bodies. They can also be employed to stop the diffusion of the electrical fluids: hence, a quantity of metal is always made use of in an electrical apparatus, under the name of the prime conductor. It is employed to receive the electrical per se; so a cylinder of white iron, or paste board with gilt paper, is made to have a communication with the globe, and as soon as the fluid is excited, it flies off to the metallic surface, which receives a quantity of it in proportion to its extent.

DCXXXIV.

No bodies in nature are more remarkably disposed to receive the fluid than the metallic substances. Water is considered as a non-electric, but it has much less power in attracting the electrical fluid than the metallic bodies; and a streamer, or stroke of this fluid, has been communicated to every distance with which the experiment has yet been made, without the smallest sensible loss of time; all other solid bodies, except charcoal, when perfectly dry, are capable of becoming electrical by rubbing, and may be used to stop the electrical fluids; but the metals never show any sign of this, and the electrical fluid has the strongest disposition to fly off along the surface.

DCXXXV.

Metals assume a fluid form, by heat, in a particular manner, retain their opacity, appear as a fluid of a bright

## METALS.

and shining surface, reflecting, in a lively manner, the image of objects that are around, as in the drops of mercury, which is, in fact, only a melted metal, and the small drops always form themselves into little spheres, in consequence of an attraction of the particles for one another, and their being repelled, in some measure, by the surrounding matter. And they assume this form not only when laid on the surface of solid bodies, but even when put into water, oils, melted earths, &c. they always form themselves globular masses, which show that the particles attract one another more than they do those of the matter that surrounds them.

## DCXXXVI.

\* To these may be also added, their malleability and ductility; though they do not all possess these, the greatest number do: they are the only bodies in nature in which these qualities are found. By malleability, we understand a disposition in the metal to have its form changed by hammering; and by ductility, a disposition to be drawn out in fine wire.

## DCXXXVII.

This is done by means of a fine plate, perforated by a number of small conical holes of different sizes, the internal surface of which is highly polished. The metal is first formed into a cylinder, the extremity smaller than the rest; then a strong pair of forceps takes hold of the extremity, and, by means of machinery, the piece is drawn through the hole, which being narrower than the piece, is drawn out to a considerable length, and diminished in its diameter, with the surface highly polished; and after being passed through one hole, it is made to pass through

a smaller hole, then through a third, till it is reduced to the fineness of a human hair.

## DCX\XVIII.

But the metals that are capable of being drawn out into wire, are not always malleable in the same proportion, nor are all the metals that possess malleability ductile. Some possess both these qualities very remarkably, as gold, silver, copper, &c. Others again are capable of being beat out into pretty thin leaves, as tin, but are not capable of being drawn into wire. Lead can be beat into leaves, but not so thin as these of tin. Iron can be drawn into very fine wire, but it cannot be beat into very fine plates.

## DCXXXIX.

In the treatment of the metals in some of these processes, it is found that they bear only a certain degree of extension under the hammer, or, in some cases, in being drawn out into wire, they acquire a degree of rigidity, which stops the further progress of their operation till they have been softened again; this occurs in gold and silver more than in copper, and still more remarkable is it with iron. When their form is attempted to be changed by hammering, after the metal is extended to a certain degree, it becomes rigid and hard; this is remedied by the process called annealing, which is the exposing the metal to a dull red heat, and then allowing it to cool slowly, when it is found to be softened so as to bear further extension; and this remedy may be repeatedly employed.

## DCXL.

In examining the effects of heat upon metals, we observe that

Each metal requires a particular degree of heat to its fusion; some the most violent degree. When melted, some of them are liable to produce violent and dangerous explosions, coming into contact with water, especially when the humidity adheres to the surface of a mould, in which a great quantity of melted matter is to be cast; for, in this case, it is applied to water very suddenly, and with an extensive surface, changing it into an elastic vapour, and producing similar effects to a quantity of gun-powder suddenly fired. This is especially remarkable in copper, which is one of those metals that require the greatest quantity of heat, to heat it to a given degree; so when it is very suddenly applied to a surface of watery humidity, it communicates a great quantity of heat, and converts it into vapour with the utmost violence.

## DCXLI.

Many shew themselves volatile in a certain degree of heat: they can be totally converted into vapour, even in close vessels, though, in general, the admission of fresh air disposes them sooner to rise in vapour.

## DCXLII.

The degrees of facility with which the different metals combine with oxygen vary, and even the aid of temperature at times renders it difficult to effect it. The combination, however, of two metals renders this process always easier effected than where they are in a separate state.

The quantity of oxygen also absorbed by different metals is equally various, as the circumstance of their combination; and each metal is capable of various degrees of oxy-

dation, at which various degrees different changes are produced on it, both in colour and other properties.

In all case, the attraction for the absorbed body is greatest at first, and lessens in successive degrees of its application; in some instances it is so great as to reduce the metal almost to an acid.

The effect of oxydation on the metal when exposed to intense heat, is either to reduce it to a state of fusion, or to form a glass of it; and to decompose it in part, or preserve still its oxydated state; or by the absorption of its oxygen entirely, and by means of another inflammable body, to restore it again to its metallic form.

Besides oxydation by oxygen, or atmospheric air, metals may undergo the same change by exposing them to substances already in an oxydated state, from which they attract the oxygen they possess, and thus decompose them; 2dly, metals also may be oxydated, by means of the decomposition of water, where their attraction to it is superior to hydrogen, and their decomposition is considerably aided by an increased temperature.

Metals may likewise be oxydated by acids, the nitric and oxygenated muriatic acids do it most readily; but, in order to their oxydation by acids taking place, some slight degree of this process must first have been in them; so that oxydation gives the metals an attraction for acids; this attraction for acids is lost by the metals being saturated with oxygen, and, in consequence, the metal becomes insoluble in the acid; a property it acquires only by abstraction of part of its oxygen.

#### DCXLII.

Metals then are inflammable substances, and these effects



of heat shew their strong susceptibility of combination: their most important combination is that with oxygen; for if a metal is heated to a certain temperature, either in contact with oxygen or atmospheric air, it loses its distinguishing qualities described, and is converted into a substance resembling an earth. This change consists in the absorption of oxygen, and the consequent oxidation or calcination of the metal.

In different metals this process takes place in different degrees of temperature, and with the same variety in its rapidity, but it is in general more rapid in oxygen than in atmospheric air.

#### DCXLIII.

The chief of inflammable substances is sulphur; and it may be united, in the way of fusion, very intimately with the metals. If the heat is only strong enough to melt the sulphur, it will penetrate and change the appearance of the metal. It acts with some appearance of violence; and there is an increase of heat to such a degree as to set the mass on fire: it appears red hot: it is also found to attract the different metals with different degrees of force, and one can be employed to separate another, and iron to separate all the rest. This separation is performed in the way of fusion; the compound flows uppermost, and the other metal falls to the bottom. But this is not necessary in all cases; in many, the sulphur may be expelled by heat alone. Sulphur cannot be made to penetrate three of the metals, viz. gold, platina, and zinc; but with regard to zinc, the facts are rather doubtful, though the *hepar sulphuris* dissolves them like the rest; we use equal parts of the sulphur and alkali, which dissolves the gold, &c. with considerable violence and rapidity.

## DCXLIV.

In mixing metals with each other, there are some exceptions; thus lead and zinc show an indisposition to unite together; it is also difficult to unite iron and mercury, though the mercury does show some power of penetrating the iron. In like manner, lead and cobalt show an aversion to unite; the lead dissolves a small proportion of it, but the remainder floats on the surface. Cobalt, too, and Bismuth, show an indisposition to unite, and nickel shows also an indisposition to combine with cobalt.

## DCXLV.

The mixtures produced are of different specific gravities, from what we would expect from our knowledge of the metals in their separate state; a mixture of mercury and silver, for instance, turns out heavier than the mercury itself, though the silver is considerably lighter; it generally happens too, that such mixtures turn out more fusible than their component parts; hence the folders for uniting the mass of metals together are generally mixtures of the same metal, with some other metallic substance. So, for gold, they use gold and silver; for silver they use sometimes the same mixture, but more commonly a mixture of silver and copper; for copper they use brass, which is a compound of copper with zinc; and, for brass, a metal still more compounded, iron, lead, and tin, being a mixture most used. It is, therefore, a pretty general rule, that the compounds of metals have more fusibility than the medium fusibility of their component parts; and it may be given as a general rule, that such mixtures

are more disposed to calcine, as in the mixture of tin and lead.

## DCXLVI.

The manner of separating the metals from one another is very precarious, and depends upon certain particular properties and differences of the metal we desire to separate; thus, in some cases, a difference of fusibility is made the foundation of separation; as with regard to lead and copper, which are often separated and mixed again, in order to extract silver from copper: the manner of separating the lead from copper is to cast the masses like flat cakes into a furnace, where heat can be raised, so as make them red hot, the lead melts and runs down through a channel cut in the floor of the furnace, into a place prepared for its reception, while the copper remains unmelted in the floor of the furnace in a spongy form; in other cases a difference of volatility is taken advantage of. Thus, when mercury, or antimony, is mixed with other metals, we can separate them perfectly, by converting them into vapour: thus we separate antimony from gold.

## DCXLVII.

The acids give to their metallic combinations a saline nature, by which they acquire somewhat of the properties of compound salts, and like them, by the union of the two substances, a saturation takes place, so that the acids lose their distinguishing property. Such combinations are soluble in water, and are termed metallic salts. The same nomenclature is also applied to them as is applied to the salts.

## DCXLVIII.

In this combination the metal exists in different degrees of oxydation, and these differences are verified by their peculiar properties and appearance.

## DCXLIX.

The metallic salts are decomposed in three different ways :

1. By the addition of earths or alkalies to their solution, from the superior attraction of these substances to the combining acid.
2. By the addition of another metal attracting the oxygen that holds the combination dissolved ; or,
3. By the addition of another acid exerting a stronger attraction to the oxyd than the one employed.

## DCL.

Metals seem incapable of combination with hydrogen or azote, in any state. Some combinations, however, take place with carbon, and they never fail with sulphur, which produce the same effects upon them as combustion. The alkaline sulphurets possess the same property, and phosphorus combines also with the metals, and they retain with it a considerable share of their metallic splendour.

## DCLI.

Combinations also take place between the metals by means of fusion, and such compounds are termed alloys, differing in the specific degree of their properties, though retaining the general one of metals.

## DCLII.

No combinations are formed with the earths, except when the metals are in the form of oxyds.

## DCLIII.

The metals are found in different states in nature, and the separation of them from their ores is a necessary point previous to their consideration.

The first part of it is to separate the ore from the great quantity of earthy and stony matter. When it is found in the vein in large masses, it may be dug up pretty clean and free of the spar, and these pieces to which the ore adheres may be fired by the hammer and chissel; but it oftener happens that the ore and spar are intermixed in small masses, and the expedients metallurgists have recourse to, is to take advantage of the difference of specific gravity between the ore and stony matter. When they are powdered, and a stream of water allowed to flow over them, it lets afloat the greatest part of the stony matter before it raises the ore. This operation is called by the English miners elutriation; there are many different methods of managing it, which produce a very exact separation of the ore from the earthy or stony matter.

## DCLIV.

When it is sand and soft clay earth, and the ore is in hard lumps, it is readily separated from it by the water; or where it is mixed with a calcareous matter, the water gradually dissolves this, and leaves only an iron ochre. But the matrix is not frequently diffusible by water, so it must be powdered by mechanical means, and for this purpose they use milns, which are wrought by water. The matrix is sometimes even harder than the ore of any metal, so the ore is reduced to a fine powder soonest, and then its specific gravity will not avail it. The heaviest

substances, reduced to a fine powder, are not easily set afloat in water; but these substances may be burnt with a brisk fire; and then throwing water upon them, when red hot, they gradually are divided into innumerable cracks; or if the matrix is sparry, it is calcined into a lime, which is reduced to powder. Upon the effusion of water, at the same time, the hasty heat melts the ore, makes the small metallic particles unite into round drops, which will more readily sink in water. So in this way the ore can be pulverized with success.

## DCLV.

But though the ore can be separated from great quantities of stony matter, it cannot be done without the loss of some of the metal, and sometimes of a great quantity of it. So they find it necessary, in many cases, to procure the separation, by bringing the whole into fusion; and this is very much practised in Germany. The ore is mixed with the fuel, and the heat raised by bellows, and they often mix stones of different kinds to facilitate the fusion. If the matrix is a stony earth, they add a quantity of the fluor fusible spar, and a quantity of the calcarious earth, which produces a more fusible mixture. If it is totally calcarious, a small addition of the quartz, or of the fluor, is proper. During this fusion a part of the sulphur and arsenic, which the ore contains, is also dissipated, and the metallic matter is more concentrated; and if any of the more calcinable metals are intermixed, they are also separated. This operation is called the crude fashion of ores, which is only performed with large quantities of earth, capable of perfect fusion, by proper additions.

## DCLVI.

When the ore is freed from all the matrix, the next set of operations are intended for separating the sulphur, or arsenic, or both. This is done by exposing the ore to the action of a gentle heat, and of the air, at the same time, before the strong fire be applied to melt the metal to a solid mass; for a violent heat occasions a loss of the metal, as these volatile substances volatilizing a portion of the metallic matter, or mixing it with the scorix, occasion part of the metal to be lost. So the ore is first exposed to the action of a red heat, long continued, which is called roasting. The ore is built up in heaps, with fuel intermixed, in a furnace of a particular structure; and sometimes the ores are roasted four or five times, where the metals are valuable.

## DCLVII.

After this operation a great part of the metal remains in the form of a calx, or oxyd; so it requires the operation of reduction to be done, which is performed in a particular furnace, the structure of which varies according to the degree of heat, and to the fashion of the place. A considerable variety is described by ancient authors, and these in use at present differ only in being larger. They consist of a tower built with a wall, into which the noſal of a pair of bellows is introduced; in the bottom there is a bed of charcoal and clay, and towards the front of this bed there is a perforation that can be opened at pleasure, and this communicates with a cavity prepared with the same materials, where the metal is to lie till it cool, and the parts separate properly from one another.

## DCLVIII.

These employed at Carron, for the melting of iron,

are incomparably larger, and swell out at a certain height above the fire, where the most intense heat is produced, that the ore may be heated gradually, and undergo a sort of roasting before it is melted. In the melting of ores in this manner, it is sometimes necessary to add particular substances, to promote the fusion of the earthy matter; or, to absorb sulphur or sulphuric acid, lime is often used, and is a necessary article in the melting of iron.

## DCLIX.

The ore requires still another operation, viz. refinement, to separate some other matters that are generally mixed with it. Few ores contain the metals from which they are denominated in a pure state, generally two or more metals are intermixed; so the last operation is to refine the principal metal from the others. The manner of doing this, with respect to each particular metal, falls to be mentioned in their treatment; it depends upon the same operations by which the metals are separated from one another. But it may be proper to observe, that there are many ores that do not require, or do not admit of all these operations, but agree with the omission of some, and the variation of other. Thus some have the metal free from sulphur and arsenic, and do not require roasting.

## DCLX.

It is proper also to mention here the art of assaying, which is a branch of the same operation. It is the art of performing all the operations upon small quantities of the substance in a short time, to judge of the nature of the ores, the manner of working them, and the profits they



will yield. It is necessary to the art of coining, and to the regulation of the fineness of bullion and p'atts. It requires the greatest accuracy and attention, as a small loss would occasion a great error in the calculation.

#### DC LXI.

The quantity being exceeding small, the different parts of the art are, 1st, The choice of the specimens to which the essayist must be attentive. The specimen should be similar to the whole mass; for if the smallest error be committed here, all his pains will be lost. When it is taken from a heap of ore it is only meant to learn the nature of the ore, and what metal it contains, without any attempt to make an essay. But in carrying on the business of mining in Cornwall, it is divided into different kinds. One set of men dig up the ore, and bring it to the day, then it is dressed, by separating the earthy and stony matter, when it is laid up in heaps. Other persons examine it by an essay, and bid a price in proportion to what they judge it contains of metals, and to the profits it will yield on melting. So the essayist must be careful in taking his specimens, to do which it is necessary to take a shovel full from the lower part of the heap, another from the upper part, another from the internal part, and another from the external or middle part; for the larger and heavier masses roll down the sides and lie at the bottom, and different parts of it may be different. But by thus taking it from different parts, and mixing all these together, the quantity will be similar to the whole. This is reduced to a fine powder, and all mixed together, and divided into two equal parts; one of these is beat into a still finer powder, and mixed and divided again. One of these halves is again mixed and subdivided

again, and thus at length a specimen of two or three ounces of it is similar to the whole mass from which it was taken.

## DCLXII.

In taking a specimen of a metal, the fineness and contents of which are to be examined, we must take pieces from different parts of the mass, as metals are cast into large masses, in the form of bars, the lower parts of which contain different ingredients; sometimes from the upper, and sometimes from the lower part: so the essayist strikes off a part from the upper part, another from the under part, another from the centre, and another from the circumference; then takes a small specimen of these.

## DCLXIII.

Next his attention must be paid to the manner of examination of the weight, in order to judge of the products, what proportion it bears to the whole; and for this purpose he is provided with a balance, constructed with the greatest nicety; the beam is generally so slender, that it is fully loaded with two ounces in each scale, and turns with the 400 part of one grain; by means of this he weighs a quantity equal to one dram. In Cornwall they use a larger quantity, but in Germany they have reduced that art to the greatest nicety, and seldom use more than one dram. They have a little weight equal to that which is the mark for a hundred weight, and they have a number of other weights that bear the same proportion to it, that the subdivisions of a hundred weight bear to it.

## DCLXIV.

They first roast the specimens in the muffle of an essay furnace, in little flat dishes. For separating the sulphur and arsenic, the fusion is then performed, by adding black flux, &c. and a little metallic globule is obtained, which is made to undergo the operation of refinement; and in order to give a certain judgment, such trial requires to be repeated two or three times.

## DCLXV.

From these general observations on the metals, we are next led to treat of them particularly, and they are generally divided into metals and semi-metals. These are called perfect which have a considerable degree of malleability and ductility; and these semi-metals, which want these qualities, and are brittle under the hammer, &c.

## DCLXVI.

The perfect metals are divided into the more perfect or noble, and the less perfect, or baser. The more perfect are gold and silver, from their resisting the injuries of the air, and the action of the more powerful agents, which affect the others called baser metals.

In treating the metals we shall begin with the one which is most generally employed in medicine; this is mercury. It has fluidity and volatility in a greater degree than the other metals, and becomes solid and malleable, when cooled to a certain degree.

## DCLXVII.

*Mercury.*

The chemists have particularly turned their attention to this metal, partly from alchemical views, and partly

with a view to medicine. From its greater density it approaches nearer to gold than any of the other metals, and it has been especially an object of the pharmaceutical chemistry since it was found to be a specific for the venereal disease.

## DCLXVIII.

In order to its application, it is necessary to make it undergo some preparation, that it be divided; for when it is thrown into the body in its crude state, its effects are very uncertain, if any. It was common some time ago to swallow considerable quantities of it; but it seldom produced any sensible effect, except when divided a little by the action of the intestines. Therefore, to have the effect in proportion to the quantity, it must be prepared by an exquisite division of its particles from one another, by rubbing it along with viscid and other substances, which divide and hinder the parts from joining themselves to one another again. Long continued agitation with water will have this effect; but the division of it is much more quickly obtained with the addition of axunge, turpentine, and other balsams, or of the mucilaginous viscid sweets, honey particularly, which is very effectual. Even earthy powders have been used; but these divide it less perfectly.

## DCLXIX.

In consequence of this minute division, it acquires a small degree of calcination, or becomes oxydated; it affects the tongue with a disagreeable taste, probably owing to an ammonical salt in our fluids, which acts upon mercury when subdivided with it. When thus calcined to a certain degree, it is more disposed to unite with saline substances; and from the facility with which it is dissolved in the animal hu-

mours, there can be no doubt that such a degree of calcination, or oxydation, has taken place.

### DCLXX.

On its chemical qualities we observe, that heat suddenly applied makes it boil and evaporate, in a degree inferior to that which makes it red hot. If that vapour is condensed, it returns again to the form of mercury, not undergoing that quick calcination that the vapour and other volatile metals do.

### DCLXXI.

From this circumstance mercury can be separated from other metals, none of which are any thing near to it in point of volatility; and this is often necessary, and happens in different arts, as in the foiling of mirrors, where it is mixed with tin and lead, and it is frequent to sophisticate it with large quantities of lead. But it is easily known when mercury contains any extraneous matters, by letting a small quantity of it stand in a vial that is dry and clean, for some time, and making it run from the one end to the other. If pure, it runs without leaving a train behind it; but if it contains only a small quantity of other metallic matter, it soils the glass, and there is seen on the surface a tough skin that is formed into folds and wrinkles, occasioning a stain to be left behind it, when running from one end of the glass to the other. This appearance, however, may be occasioned by humidity, or more readily by oil. If this is the case it can be easily purged, by draining it through leather or linen, squeezing it over a funnel to make it run into a dry vial, when it assumes the ordinary appearance of pure mercury; or, by passing it through a cone of paper,

with a small hole in the extremity ; for any foulness which it contains, by grease, will remain in the cone ; while, if it contain any other metallic matter, it will, in a short time, recover the same appearance of foulness ; from which we know certainly that it is impure.

## DCLXXII.

There is no other way of purifying mercury but by converting it into vapour in a small glass retort and receiver. It is not necessary to put in water, as it is easily condensed, if the heat is moderate. It is usual to add a quantity of iron filings during this distillation, the effect of which is to give it the appearance of pure mercury to a greater degree than when it is distilled by itself ; but at the same time it is attended with a quantity of greasy matter, which the iron filings contain, from the smiths using so much oil. This is easily separated by drying it on a plate before the fire, and then passing it through a cone of paper ; after which it appears brighter than when distilled by itself.

## DCLXXIII.

Mercury, thus hastily converted into vapour, condenses again, and it does not bear to be long exposed to this heat, without undergoing some calcination. If we simply distil it three or four times, it begins to undergo a calcination very slowly. In the bottom of the retort there is a quantity of reddish powder, which is a calx or oxyd of the mercury. This has given occasion to the contrivance of an apparatus, and a process for calcining mercury. It is a vessel in the shape of a matraass, wide at the bottom, sometimes spread out very wide, and flat and contracted towards the top, with a high dome. The

bottom is covered with mercury, which is exposed to the air with a greater surface, and set in a furnace, with a degree of heat that it can bear without being converted into vapour; only a little vapour is raised, that will be condensed, and fall down again. After some weeks we can perceive some calx or oxyd, formed into little flat masses floating on the surface, and by continuing the same heat, for a number of months, a greater number is formed; but it will require a year or years to convert it all into calx. The heat it bears is so moderate, that the air has little power in calcining it.

## DCLXXIV.

Thus mercury requires a strong heat to convert it into vapour, equal to 600 or 550. It must be heated to a red heat; but it will arise, and may be condensed again, forming transparent crystals of a deep red colour, and which are a simple calx or oxyd of the metal, and it may be restored to its metallic form by exposure to heat, in contact with inflammable substances. This preparation is an article in the London dispensatory. Whether the apothecaries are furnished with the genuine preparation is doubtful, from the long time it requires. There are druggists in London who may have it genuine; but the *mercurius calcinatus*, or red oxyd of mercury, in general is some other preparation substituted in its place.

This oxyd is very soluble in all the animal humours, and in all the acids.

## DCLXXV.

But the greatest variety in the preparations of mercury is from the operation of acids upon it; and first, with regard to the sulphuric acid. This acid, applied without the assistance of heat, produces no effect: it must be

assisted by the strongest heat that this acid can bear, and it must be in its strongest state. Thus the acid being made to boil, an effervescence is observed, the mixture assumes a brown colour, steams arise which have a strong odour of the sulphureous acid. At the same time, while the mercury is dissolved, it is gradually converted into a white saline matter. Thus combined it has little solubility; it consists of minute crystals; it is very ponderous, from the quantity of the mercury; and highly corrosive, from the quantity of acid. It cannot be decomposed by the application of heat; it requires a stronger heat to change it into vapour than either the acid or mercury alone.

## DCLXXVI.

When the heat is increased, this compound arises entire, without any separation of its parts; but water added does in some degree decompose it. When we put it in warm water, and agitate the mixture, the colour of the compound is changed into a bright yellow, the water separating part of the acid, and leaving the mercury in the form of a calx or oxyd, which is of a red or yellowish colour; this is called turbeth mineral, or sulphate of mercury, and it ought to be washed repeatedly, till the water comes off insipid. This preparation varies in strength according to the proportion of the oxydation, or the quantity of oxygen combined. It is decomposed by alkalies and lime, but is only partially decomposed by ammonia.

## DCLXXVII.

The nitric acid acts more violently upon the mercury. By this decomposition a large quantity of nitrous gas is



discharged, the metal is oxydated, and combines with the remaining acid. The decomposition is more moderate if the acid is diluted with more than an equal part of water, and the metal is also only imperfectly oxydated. But an increase of oxydation may be completed either by strength of acid, or by a diluted acid assisted in its action by heat. The products of these oxydations are salts soluble in water, chrySTALLIZABLE and extremely caustic; and the difference of their oxydation is rendered conspicuous by the addition of an alkali, particularly ammonia, which occasions the precipitate of the one to be black or grey, and of the other of a white colour. This decomposition is farther assisted by heat; for the mercury attracting more oxygen, nitrous gas is expelled, and a red mass remains, which consists of the perfect oxyd of mercury, known by the name of red nitrat of mercury.

The combinations of mercury with the nitric acid are decomposed both by the alkalies and several of the earths.

Either of the fixed alkalies, or lime added to the diluted solution of the weak acid, without heat, occasions a greyish precipitate to fall; and to the other solution with the strong acid, assisted by heat, it occasions a yellow precipitate to be formed.

#### DCLXXVIII.

But when ammonia is employed it produces a different effect; it precipitates the mercury from the cold solution in the weak acid in the form of a grey coloured powder, containing the metal in its lowest oxydation; or it may be considered as mercury simply divided into exceeding minute parts, with no more calcination than what takes

place in the triturated preparations; and when we rub it on the surface of gold, it adheres and whitens it. This depends on the hydrogen of the ammonia attracting part of its oxygen at the moment of its separation. When the ammonia is added to the highly oxydated solution, the first quantity added precipitates it in the form of a white powder, or a grey coloured one is thrown down. In both solutions, as part of the mercury generally exists in both states of oxydation, so the addition of ammonia produces a precipitation of both kinds, and thus a grey or light blue is formed; but when, for the purposes of medicine, the mildest precipitate is preferred, an attention should be paid to the diluteness of the solution, and the absence of heat.

## DCLXXIX.

The muriatic acid does not act on mercury, unless the metal be previously in a state of oxydation, and then it has a much stronger attraction for it than any other acid. We apply the acid in its pure state, or some compounds that contain it, and that may be decomposed in any heat, when we have a most intimate union, and obtain a very volatile substance, which easily rises into vapour, and can be condensed without any separation of its component parts. It is separated by sublimation, so called mercury sublimate, or muriated mercury.

## DCLXXX.

The muriated mercury, or corrosive sublimate, has the form of a white salt, which is very ponderous, and being heated proves more volatile than mercury alone, and rises entire, without any separation. But the par-

ticular mode of procedure, in performing this operation, has been greatly diversified.

## DCLXXXI.

The best mode of preparing the corrosive, or muriated mercury, is,—To mercury calcined, by means of the nitrous and muriatic acid, we add an equal weight of common salt, and as much vitriol from which the water has been evaporated. When this mixture is heated the acid attracts the alkali of the common salt, and detaches the muriatic acid in strong fumes, which unites with the calcined mercury, and forms the saline compound, which being volatile, immediately rises in vapours, and is condensed in the upper part of the glass; but in the beginning of the operation there is a small quantity of watery vapours, which rises from the mixture. It is impossible to mix saline substances without attracting humidity, and a small portion of the nitrous acid is expelled. So it is necessary to make some provision for the condensation of the acid steams, by applying a capital to the top of the subliming vessel, whereby the liquor runs off, while the corrosive sublimate condenses in the upper part of the glass.

## DCLXXXII.

Muriated mercury forms a compound that is totally soluble in water; but when the acid is too little, a portion only dissolves; but in all cases it requires a pretty large quantity of water. We promote its solubility by adding a little of the muriatic acid, or some muriat of ammonia, ~~or~~ crude sal ammoniac; the muriatic acid of that compound salt acts upon the corrosive or muriated mercury, so as greatly to promote its solubility; and a quick

medicine of Ward is supposed to contain mercury combined with nitrous acid, the solubility of which is increased by its combination with an ammoniacal salt. Though this mercurial salt is used as an internal medicine largely diluted, and is found of great efficacy, and sufficiently safe, it was considered some time ago as one of the greatest poisons, and only applied externally. It was chiefly made for obtaining some other preparations, as mild muriated mercury, or the *mercurius sublimatus dulcis*, which is made by mixing crude mercury with the corrosive sublimate, in equal quantities. They are carefully ground together and combined, so as to form a white powder, which requires a strong heat to convert it into vapour, and it forms a more dense cake; it has less the appearance of a salt, and is considerably heavier. In this compound the oxygen of the corrosive becomes attracted by the mercury, it loses its corrosive quality, is reduced to an imperfect oxyd, and is perfectly mild. This mildness we find directions to improve by repeated sublimations; but the effects of these are doubtful.

## DCLXXXIII.

The most proper method to render the *mercurius dulcis* mild, is to reduce it to powder, and boil it in water, when the acid is dissolved in the water, and that is the proper way of edulcorating it.

## DCLXXXIV.

Though the acid cannot be separated by any of the other acids, it is separable by alkaline substances; the fixed alkali or quick lime, or ammonia, produce this effect, when to a solution of corrosive sublimate we drop in some fixed alkali; it is precipitated in the form of a

brown or orange coloured powder. Lime water precipitates it much in the same manner, when a certain quantity is added, but the colour is not so deep; it is changed into a yellow precipitate, like turbeth mineral. Ammonia precipitates the mercury in the form of an exceeding white powder.

## DCLXXXV.

This precipitate from the ammonia is one of the white precipitates in the London dispensatory. It is produced by a process by which the same thing is brought about: by dissolving in water, the muriated mercury, or corrosive sublimate, and crude sal ammoniac, or muriat of ammonia, and adding a fixed alkali. But in chemical authors there is another white precipitate of mercury which cannot be distinguished from this. It is produced by adding to the diluted solution of mercury in the nitrous acid some common salt, while the acid of the common salt attracts the mercury, and the compound being less soluble in water, it falls to the bottom in the form of a powder, or of small crystals forming a white sediment, which is called white precipitate of Dr. Boerhaave. But it is a corrosive sublimate, only not completely oxydated, or containing such a large quantity of acid as when obtained in the way of sublimation, but it is totally soluble in a sufficient quantity of water.

## DCLXXXVI.

The alkalies, or lime, precipitate from the mild muriated mercury a greyish precipitate. When ammonia is added, it is black, and partly deoxydated.

## DCLXXXVII.

Such are the principal forms which mercury has been

made commonly to assume by means of salts; but there are methods of combining it also with other saline substances. The fixed alkali, in some cases, is made to dissolve it, and the vegetable acids are easily combined with it; but when calcined by heat and air, or oxydated by other acids, they dissolve it more perfectly, as vinegar or tartar; and Keyser's pill contains a mercury prepared in this way.

## DCLXXXVIII.

From this view of the effects of the saline bodies upon mercury, it puts on a variety of shapes, as of a red, yellow, white, or other powder; sometimes of transparent fluids, according to its degree of oxydation from the acid. From these combinations it may be separated again, by mixing such preparations with an equal weight of iron filings or fixed alkali.

## DCLXXXIX.

The dried oxyds precipitated by ammonia or lime, and triturated with  $\frac{1}{2}$  their weight of sulphur, detonate or form fulminating mercury. Another preparation of the same kind is formed by a solution of 100 grains of mercury in  $1\frac{1}{2}$  ounce of nitric acid, assisted by heat. The cold solution is then poured on two ounces of alcohol; and by the application of heat a precipitate is formed, which, washed and dried, forms fulminating mercury,  $1\frac{1}{2}$  grains of which struck on an anvil, violently explode.

## DCXC.

With regard to the earthy bodies, there is little to be observed with respect to their effects upon mercury, except the calcareous earth, or quick lime, is sometimes

used to separate the acid from mercury, to revive former preparations of mercury. But mercury may be combined with some of the inflammable substances, as sulphur, and that either by long and patient triture, or more readily with the assistance of heat. The compound, or sulphuret of mercury, is of an intense black colour, and is called *Æthiop's mineral* on that account. When prepared by triture it acquires a good deal of time; it is first divided into globules, which becomes less and less, till it assumes a grey colour. By continuing the rubbing it becomes blackish; but this serves only to bring the particles of mercury and sulphur within the sphere of attraction; and it is only by the action of that attraction, bringing them into closer union, that a perfect *Æthiop's mineral*, or sulphuret, is produced.

## DCXCI.

They unite more perfectly with the assistance of heat. If the sulphur is melted and poured warm into it, the mixture grows hot, and the sulphur takes fire; and united in this way, they cohere more strongly; for heat being applied to the mixture formed by triture, a part separates; but when they are united, by means of heat, they only sublime together, and assume a deep red, and when reduced to powder the colour is very bright. It is known by the name of *vermilion*. The change of colour proceeds from a slight calcination, or partial oxydation. In the conduct of the process, it is necessary to employ a strong heat in close vessels, which are coated, or in earthen vessels; and the heat is so strong, that a quantity of fumes is blown out of the vessel, in order to dissipate the superfluous quantity of sulphur present in the *Æthiop's mineral*, more than what is necessary to constitute a proper ver-

million. A quantity of this arises and takes fire, and the cinnabar or vermillion requires a strong heat to its sublimation, and continues in the neck of the vessel.

## DCXCII.

The mercury is easily restored to its ordinary state by means of iron filings, quicklime, or fixed alkali, in a strong fire, but the iron filings restore the mercury the most readily, the sulphur uniting with the iron, and detaching the mercury.

## DCXCIII.

Applying mercury to the other metals, there are three or four with which it unites but very imperfectly, iron, arsenic, platina, and antimony, the combination of which is very imperfect, and the antimony is not retained for any time. It has a particular effect upon arsenic, when it is fused, with inflammable matter: if it is ground with mercury, and the mixture heated by distillation, the arsenic arises pure.

## DCXCIV.

Mercury can be mixed with many other metals, and these mixtures are called amalgams of mercury. If much mercury is used, they appear like mercury. If more of the metal, but less than an equal weight of it, is used, we have a solid bright mass of a white colour, the mercury holding the colour of the metal. In such mixtures, though the other metals appear equally mixed, this does not seem to be the case; for when we put such a mixture in a leather bag, and expose it to some pressure, a quantity of fluid mercury separates by itself, the remainder forming a mass of a considerable degree of solidity, and



which consists of equal parts of the metal and mercury ; so there is a certain proportion of the mercury which unites itself more strongly, and forms a sort of small crystals ; and the rest of the mercury only dilutes this, without mixing in an equal manner. But if such a mass be mixed by long grinding or digestion, the mercury is more closely united, and the other metal more equally diffused. Upon this has been founded the art of separating gold and silver, particularly gold, from the earthy and stony matters with which it is always intermixed, and the foiling of glass for mirrors, for which a sort of amalgam, or mixture of mercury with tin is used. From this also is derived the art of gilding copper, silver, and brass : by dissolving gold in mercury, and exposing it to heat, the mercury evaporates, and leaves the gold. It has been employed to dissolve a leaden ball deeply lodged in a wound, and it serves many useful purposes in medicine and surgery, or it may be employed to take a gold ring off a swelled finger ; it will penetrate it, and render it quite brittle, so that a slight stroke will make the ring fly in pieces.

## DCXCV.

With regard to its origin, it has been commonly observed that it is a metal which occurs more rarely and in smaller quantity than gold ; and as it is more useful than gold, it ought to be more valued, if things were valued according to their intrinsic worth or usefulness. The only mines, in which it was found are those of Spain and Hungary, and some in the East and West Indies ; these last are the most famous, and have yielded it longest. Great quantities of it are found, in its metallic state, among earthy and stony matter, generally in very small

globules. But in some parts it is collected in such quantity that the workmen are exposed to danger, from the violence with which it rushes out of the caverns, when they break them open. It is found too intermixed with the ores of metals, even in hard flint, and in pyrites; and a variety of the ores of other metals have globules of mercury intermixed. But it is more frequent to meet with it in the form of an ore, as combined with sulphur, either constituting a dark red mass, or produced by the artificial compound called native cinnabar, or they are so united as to form a black substance, like the artificial *Aethiop's mineral*.

## DCXCVI.

The native cinnabar is very like the artificial, but not so stiaited: it is generally in hard lumps; but when ground to a powder it produces a colour as bright as the other. It is extracted from these ores always by means of heat. When a small quantity is to be examined by an essay, it is usual to put it into a glass retort, and to add a quantity of iron filings, and the mercury comes over in its metallic form. If it is only combined with earthy matter, heat alone will serve. When the quantity is large they take an iron pot, and fit it to an iron plate, which is perforated with holes. This is inserted into another, with a large mouth; a fire is put round the upper pot, to the degree of producing an obscure heat, while the lower pot is kept cool, by its communication with the ground, &c. But at the mines they follow a method which is still more simple, they have a furnace in the form of a lime kiln or draw kiln, only it is vaulted, and there is no issue for the smoke above; there is only a door by which the workmen enter occasionally,

and a communication with a little chamber, from which there is an issue for the smoke. This furnace is charged with the stones, and other materials which contain the mercury; the mercury is converted into vapours, which pass along the horizontal vent, and are conducted into the chamber where they are condensed, so that only the smoke of the fuel escapes. In this way large quantities are managed at once, with no expence of vessels, and with very little attendance.

## DCXCVII.

*Antimony.*

The more volatile and brittle metals, which, for want of ductility are called semi-metals, next follow:

The first of which is antimony, or rather sulphuret or regulus of mercury. It has the name of regulus, because it is extracted from a compound which contains it. The chemists do not find this metal in the markets in its pure state, they are only furnished with a compound that contains it, so are obliged to perform an operation upon it; and as they give the name of regulus to metallic lumps, produced from other substances, in crucibles, this has got the name of regulus of antimony. It has been much wrought upon by the alchymists, for what reason is not known, and it has been changed into a variety of shapes, for the purpose of medicine.

## DCXCVIII.

It has a white colour, approaching to that of silver, but it is quite hard and inflexible, breaks in pieces upon being struck, and the fracture represents a number of planes, composed of an assemblage of plates cohering together. This particular appearance proceeds from

some particular sort of crystallization in its congelation, which makes the parts collapse in this particular manner. It melts in the lowest degree of red heat; if the heat is increased a little more, especially if the air be admitted, it evaporates fast, sending out white fumes; and if a solid body is exposed to it, it condenses it in the form of a white powder, which is found to be an oxyd of the metal. If these steams are confined in the vessel, they give another appearance, and become a sublimed oxyd. When the matter is put into a crucible, and exposed to a strong red heat, only allowing a slow circulation of air through the vessels, the steams are calcined more slowly, and condense into small shining specular bodies, which have a silvery whiteness, and from their resembling snow and silver, are called the silvery flowers, or snow of antimony. But we may calcine it by means of heat and air, without converting it into vapour. We reduce it to a fine powder, and expose it to a dull red heat, without melting it, when it becomes an imperfect oxyd, and the powder assumes a grey colour, and then becomes yellowish, and by the continuance of calcination it becomes white.

## DCXCIX.

The oxyds of this metal have different degrees of fusibility, as they are more or less oxydated. Those that are perfectly white cannot be melted with any degree of heat, but evaporate when exposed to a very strong heat and the action of the air at the same time. They are easily reducible to their metallic state or form, by melting them with charcoal dust, or black flux, or a mixture of fixed alkali and oil, that is soap, which forms a charcoal by heat.

## DCC.

In mixture the acids all act upon antimony one way or other. Some of them act upon it in its metallic form, others when it is slightly oxydated; but when it is highly so, none of them have much effect.

The vitriolic acid will not act unless it is strong, and also with the assistance of a strong heat. It is then in part decomposed, and the oxyd formed combines with the remaining acid, composing a salt not crystallizable.

The nitric acid oxydates and dissolves this metal in the cold, the evaporated solution affording a salt deliquescent, and decomposed by heat.

The muriatic acid scarcely acts upon the metal, and it even dissolves its oxyd slowly; but by adding a small quantity of nitrous acid, producing the compound, which is known in chemistry under the name of aqua regia, or the nitro muriatic acid, it dissolves it briskly, red steams are thrown out; and the solution, when evaporated, forms a concrete, termed butter of antimony, which melts on the application of heat.

## DCCI.

The same preparation is composed also in a different way, by mixing the compound of mercury with the muriatic acid, that is, corrosive sublimate with the antimony. Steams arise that condense in the retort and receiver, partly in a fluid form, partly of the consistence of butter, and thus also is obtained the butter of antimony.

## DCCII.

This kind of sublimate, or butter, is always in part of

a middling consistence at first; but if it is kept a little exposed to the air, it attracts humidity very strongly, so as to assume a fluid form, and appears very like an oil; but still it retains the name of butter of antimony, or more properly the antimonial caustic, in the London dispensatory. It has the same corrosive quality that the mercury sublimate has. When water is added in large quantity to this compound, it produces a similar effect upon it as upon the compound of mercury and the sulphuric acid. It attracts the acid, and occasions the antimony to be precipitated in the form of a white oxyd; the whole of the acid is washed off, and is called *mercurius vitæ*, or the powder of algaroth, but improperly, as it does not contain the smallest quantity of mercury.

## DCCIII.

The same metal can be combined with vegetable acids, chiefly in their oxydated state. Various liquors become violently emetic by means of it. Some time ago this emetic wine was obtained in some of the foreign dispensaries, in a particular manner. Cups were cast of this metal, and the wine being allowed to stand in them became emetic, and the quantity of the metal was so small that the cups might serve for ever. But the methods which are now practised are much more certain and convenient.

## DCCIV.

With respect to the neutrals, regulus or sulphuret dissolves with nitre, and a quantity of white fumes arise, which is found to be an imperfect oxyd of the metal, termed white oxyd of nitre, and which is found to

be less fusible, according to the quantity of the nitrous acid.

## DCCV.

Antimony, in the ore, is blended with earth and stones, and is separated from them by putting it into a crucible, perforated in the bottom, and made perfectly close above. One of these crucibles is put upon another crucible, with a hole in the lid of it; and to support the antimony in the undermost, it is surrounded with sand. Over these a fire is put, to give an obscure red heat. When the metallic matter melts it becomes fluid, and runs through the perforation, leaving the earthy and stony matter behind it. The dross remains in the upper crucible, consisting of stony matter, appearing porous from the separation of the antimony, and of a black colour, from a portion of the mineral still adhering to it. The matter collected in the lower crucible is the metallic matter, combined with sulphur, and in that state is called crude antimony, or sulphuret of antimony. It melts with a gentle heat, and the parts, in cooling, crystallize in oblong needles.

## DCCVI.

As this is the only operation to fit it for sale, and as it comes in this state into the hands of the chemists, all the operations are to be considered as done upon this compound of crude antimony, and the effect from the application of heat, in different circumstances, and of the different active solvents, will be understood from the knowledge of the two constituent parts, sulphur and the metallic matter. The modicum it evaporates when heat is suddenly applied. Its evaporation is attended with a degree of inflammation, which is visible in the dark;

there is a pale blue light, as the sulphur is the most volatile part. It evaporates the most copiously first; and if a more moderate heat is applied, the sulphur may be totally dissipated, with little loss of the metallic matter. In this case the antimony is to be reduced to a gross powder, and spread upon the earthen vessel, which is gradually heated to the lowest degree of red heat, the sulphur evaporates, a luminous vapour hovers over the antimony, and the smell of burning sulphur continues some time; what remains is an oxyd of antimony.

## DCCVII.

It is from an oxyd obtained in this way that the glass of antimony is prepared. The roasting being so managed as to produce an imperfect oxydation, therefore it is stopped at a certain time, which is judged of by the appearance of the oxyd. Being then put into a violent fire, it melts perfectly into a vitreous mass, and produces what is called glass of antimony. As it is covered with a deep yellow or red colour. If the glass is more highly oxydated, the colour is paler. If it is not sufficiently calcined, the colour is too dark than it appears black or opaque. Such therefore are the effects of heat upon crude antimony.

## DCCVIII.

In examining the action of the compound alkali on sulphuret of antimony, we find the fixed alkali strongly attracts the sulphur, and acts upon it in the state of a watery solution, but more readily in the way of fusion. The antimony is reduced to a powder, and mixed with the alkali which readily melts it—the alkali is united with the sulphur, and composes a heavy sulphureous mass.



is a powerful dissolver of the metals in fusion. It is a solvent of many with which the sulphur cannot unite, as gold, tin, &c. So it does not occasion any separation of the metallic matter which remains combined with the hepar sulphuris thus formed, and the whole is blended into a glassy-like compound.

## DCCIX.

If but a small portion of alkali, as one part to five of crude antimony is used, it produces the mass called *regulus medicinalis*. It is of a black colour when reviewed in the mass; but by the change of colour it has some little degree of transparency, producing a powder of a reddish or snuff-colour. With large proportions masses are formed, which prove more or less soluble in water, as when one part is melted with two of the antimony. This mixture has such an attraction for water, as to deliquiate when exposed to damp air. The most proper name of these is hepars, or sulphurets of antimony, as their quality depends upon the quantity of sulphur they contain.

## DCCX.

There is another way of producing sulphurets or hepars soluble, by applying the alkali in the state of a watery solution to the antimony; but it dissolves it more completely when it is heated. Upon this occasion the metallic matter is dissolved along with the sulphur. The alkali does not attract the sulphur so strongly as to occasion a separation of the metallic matter; the sulphur does not adhere to the alkali so strongly as pure sulphur would do, and requires more water to its solution. The decomposition appears, when to the solution of the antimony is added a

small quantity of an acid. There is a copious precipitation of the reddish or orange coloured matter produced, which is attended with the same foetid smell which commonly attends the decomposition of the hepar sulphuris, and a hydrogenated hydro sulphurated antimony is precipitated, or Kermes mineral. In this precipitation the antimony proves more active as a mineral. Unless the process be properly managed, that a sufficient quantity of the acid is employed, it is liable to turn out unequal. When we use an ordinary fixed alkali to act upon the crude antimony, it will not act but with the assistance of a boiling heat, and the greatest part of the solution separates upon cooling, forming a precipitate of an orange colour. This precipitation is called sulphur auratum antimonii. The chemists have given fanciful names to such preparations, from the opinion they had of their virtues; but in the London dispensatory it is more properly called sulphur antimonii precipitatum.

## DCCXI.

The Kermes mineral has been highly valued in France, for a long time; it is very similar in appearance to the precipitate, which is separated in this manner, by an acid only; the colour is not such a bright red. The Kermes mineral retains a small quantity, however, of alkali, which the other is free from; and the alkali diminishes the quantity of acid in the stomach, upon which the activity of the antimonial medicine, not combined with acids, depends.

## DCCXII.

The preparations by means of nitre, or nitrat of potash, fall next to be examined, and of these there

are only two or three preparations now employed; 1<sup>st</sup>, The *crocus medicinalis* consists in mixing one part of nitre with eight of antimony, which is so small a quantity that it hardly produces any deflagration; but it promotes the solubility of the mixture, and makes it break like glass, without any sensible degree of transparency, but it has a brightness resembling that of polished steel; it produces a powder of a deep red colour, similar to that of sulphuret of antimony, mixed with a small portion of alkaline salts.

## DCCXIII.

Different proportions of the nitre and antimony have been used, as two parts of antimony to one of nitre, which produces the preparation which Lewis calls *crocus antimonii minor*. But that commonly called *crocus antimonii*, and known in this country by the name of *crocus metallorum*, consists of equal parts of the antimony and nitre; and here the nitre deflagrates very violently. By this proportion a mass is obtained, which, on inspection, consists of a whitish matter that is more saline, and a vitrified substance of a deep yellow or reddish colour is produced. If the whole is melted in a crucible, they separate more completely; the vitrified matter is found by itself, resembling the liver of some animals, so by some is called the liver of antimony; but it is better to confine that term to the preparations with alkaline salts.

## DCCXIV.

If two or three parts of nitre is employed, the sulphur is more completely consumed, and the metallic part calcined into a white oxyd. It consists of the calx of antimony, which when separated by water from other matters,

affords a white calx or oxyd, called diaphoretic antimony. James's powder is a preparation like that: from the most authentic accounts it appears to be crude antimony, from which the sulphur is to be evaporated, by roasting, and the calx is mixed with an equal quantity of nitre, and kept red hot, which burns the sulphur and oxydates the metallic matter to such a degree as to render it soluble in acids. When it is calcined to a still higher degree, it loses its solubility in acids, and it is freed from every extraneous saline matter by water. In the Edinburgh dispensatory it is called calx antimonii nitrata.

## DCCXV.

Wine, and the acetous acid, dissolve antimony. The tartarous is also much employed, and the principal medicine now universally used is the emetic or antimonial tartar. The tartarous acid does not act sensibly on the crude antimony but when moderately oxydated and rendered soluble in acids. So both this preparation and the wine of antimony are prepared with washed crocus, or the nitrous oxyds.

## DCCXVI.

The crocus, or nitrous oxyd, is obtained by mixing equal parts of antimony and nitre, and deflagrating the mixture. This renders the metal fusible, being in that moderate state of oxydation in which it is most soluble in acids, and this repeatedly washed in hot water, is called the washed crocus of antimony. But in the apothecaries' shops we meet with a preparation which is totally different from this, and has the opacity and black colour of the regulus medicament, and if ground to powder it has a dark, dirty, purple colour, whereas the crocus is of a deep yellow, or the colour of the liver of some animals; and the powder

is of a bright yellow colour. This false preparation is formed by melting and deflagrating the antimony with an under proportion of nitre, or they even use a portion of fixed alkali instead of nitre. A great quantity of this preparation is used for horks, and the demand for it has occasioned attempts to prepare it cheaper, so they have left out a considerable part of the nitre, as being the most costly article; here therefore the greatest part of the sulphur remains, and the metal has little more solubility than the antimony in its crude state; and hence we have had so many complaints of the uncertain efficacy of the tartar emetic, or tartarised antimonial wine.

## DCCXVII.

It is true that there are other circumstances which may occasion a difference of strength. Thus with respect to the vinum emeticum, the wine may vary in acidity, or its quantity of oxygen, and dissolve only a portion of the antimony, in proportion to its acidity. And in preparing the tartar emetic much depends upon the fine pulverization of the glass, as solid substances are dissolved the more readily the more subtilly their surfaces are divided. It is also necessary to keep the tartar boiling, when it acts upon the antimony, as it is not soluble in cold water itself, and we must use a proper quantity of water to keep it dissolved; it must exceed the quantity of tartar at least 24 times, otherwise it will not act properly, not being held dissolved; and the apothecaries, not attending to these circumstances, have produced tartars very different in point of strength.

## DCCXVIII.

In order to find a means of enabling us to judge of the

are properly prepared, we do it by examining its solubility, it being the more soluble the more it is saturated with antimony; and the difference of emetic tartar, in this respect, is very considerable, though now the preparations in Britain are generally of the proper degree of strength, and if rightly prepared, one ounce of water will dissolve 52 grains.

## DCCXIX.

*Bismuth.*

Bismuth, the next metal, bears a considerable resemblance to antimony in its external appearance. It is nearly as brittle, though it bears an impression from a stroke of the hammer which antimony will not do, but breaks like glass. When broken it shews an assemblage of plates, with a shining surface; besides, it is much heavier than antimony, and the colour is a little yellowish, of a reddish cast. It is also more fusible, melts long before it becomes red hot, and melts into a more fluid substance in the fire than most of the other metals do. It is also less volatile, though it evaporates in a strong heat. It is easily oxydated, and the oxyd is easily fusible in a moderate red heat. It is one of the most powerful solvents of the earthy substances, with which it forms a glassy compound. In these properties it greatly resembles the oxyd of lead.

## DCCXX.

The oxyd is got from bismuth, by exposing a fresh surface to the air, or more quickly by scorification. It runs off the surface of the metal like oil, and leaves a fresh surface exposed to the air. The calx concreting after fusion, forms a mass of a foliated texture, like the oxyd of lead.

The action of the acids on bismuth is pretty much the same as on the other metallic substances.

The sulphuric, by the assistance of a boiling heat, oxydates, and dissolves a part of the metal; but the nature of the compound has not been particularly examined.

The nitric acid is the most ready solvent of the bismuth. The muriatic does not act so well. The nitrous dissolves the bismuth with violence, and copious red vapours break out, consisting of nitrous gas and nitrous acid. At first the solution is of a greenish colour, but upon standing some time it becomes colorless, or of a green colour is very much diluted. The solution, mixed with water, is decomposed, and a white precipitate is precipitated, which is an oxyd of the bismuth, and is called magistery of bismuth, and is supposed to be the pearl white, which is sold by the perfumers as such. But the pearl white is supposed to be a combination of the oxyd of bismuth with a small quantity of tartar, the bismuth being precipitated from the nitrous acid by means of tartar dissolved in water or a solution of soluble tartar, whereas this precipitate by water retains a small portion of the nitrous acid, which renders it highly corrosive and unfit for what the pearl white is employed for.

The muriatic acid has little attraction on bismuth, except when an oxyd, or when it is used in a boiling heat. The muriat of bismuth distilled forms a thick soft mass; but it has been found applicable to no particular purpose.

The acetic acid produces an acerbent styptic solution.

The alkalis dissolve it after it is precipitated from acids, particularly the ammonia.

With sulphur it forms a mass similar to crude antimony; and what is particular, the oxyd combines with the sulphur as well as the metals.

## DCCXXII.

Several experiments have been made upon the mixture of bismuth with other metallic substances. Zinc and cobalt can be made to combine with it. The effects it has upon the rest are generally to change their colour and render them brittle, and these metals which are calcinable do so more readily when mixed with bismuth. Such compounds too are remarkably fusible, more than in proportion to their fusibility in their separate state; so it enters into the composition of the folders of the more fusible metals, as for lead and tin, and on this account it forms with mercury more fluid amalgams, added to other metals; as in dissolving lead lodged deep in wounds it may be added to the mercury. Some time ago it was said to be made use of for adulterating mercury, enabling it to dissolve more lead; but the appearance is so different when the mercury contains other metallic substances, that it is not easy to deceive persons who have the least skill in that matter.

## DCCXXIII.

Sometimes a little of this metal is added to the composition of printers' types, to make it more fusible. Mixed with lead, tin, and mercury, it forms a fluid amalgam, with which the inside of glass globes are soiled. When warmed this mixture leaves a train behind it, and soils the glass, as the globes can be soiled by means of a small aperture on one side of it, at which the mixture is poured in, and when cold it becomes hard.



## DCCXXIV.

With regard to its origin, it is found most plentifully in Saxony; some of it is also found in France and in England; veins of it are found containing no other metal: but more commonly it is found in ores which are highly arsenical, as in the ore of cobalt, as is the case in Saxony. It is separated by the operation of roasting, as the arsenic is separated. The sole of the oven has an inclination to one side, and the bismuth melts by the heat raised for separating the arsenic, and runs down to the lower side, where there is a channel, conducting it into a receiver, the calx of the other metal remaining alone on the floor.

## DCCXXV.

*Zinc.*

The next metal bearing some resemblance to antimony and bismuth, is zinc. It has a plated texture, a greater degree of softness than bismuth. It will admit of being lengthened out to some degree, so it is more difficultly broken in pieces. It cannot be powdered by pounding, as the other two, and the colour inclines to bluish, resembling more the colour of antimony, but it has more of the bluish cast. It is among the more fusible metals, and melts when red hot. In a white heat, in close vessels, the whole arises in vapours, and is condensed again without any change; but in the open air it takes fire, and burns rapidly, with a crackling noise, and smoke arises which adheres to any body in the way. So the most easy way of calcining it is to place a crucible in a melting furnace, with about one ounce of the zinc put into it. When heated to a strong red heat, it begins to take fire, at least upon being stirred with an iron rod, which breaks a cal-

cined pellicle upon its surface, and admits the air, and the oxyd is condensed upon the side of the crucible, or a great part of it attaches itself to the bottom around the burning zinc. When a certain quantity of the oxyd is produced, it is very bulky, and then it is necessary to stir it again, and expose the surface of the metal to the action of the air. When it is totally burnt we put in a little more, and carry on the operation till that is likewise burnt; then we may take out the oxyd which is formed, as the quantity will prove an obstacle to the convenient calcination of any more: it is done with an iron spoon. This is the most convenient process.

## DCCXXVI.

This metal shews the strongest attraction for acids of any whatever. It is oxydated, and dissolves in them all, without exception; in most with great violence.

The nitrous acid dissolves it with heat and ebullition, and the extrication of red vapours, or nitrous gas, as usual. And the sulphuric and muriatic acids also dissolve it with great effervescence.

The vegetable acids act also very readily on it, and acquire a sweetish styptic taste, as from lead.

## DCCXXVII.

With regard to the other metals there are none with which it will not combine, except bismuth and nickel. It is disposed to unite with iron, but the iron must be heated so much that the zinc takes fire, and is lost; and in this case it is apt to carry off a part of the other metal, particularly of those metals which are most calcinable. So it has the least effect in this way upon gold and silver.

## DCCXXVIII.

The most useful combination with tin is to produce the compound called pewter. Tin is the predominant ingredient, but by itself it is too soft, and it is necessary to add other metallic substances to give it hardness, and zinc answers the best, its whiteness resembling that of silver, only it is too easily affected by acids.

## DCCXXIX.

With copper zinc produces brass, and other compounds, called, by the soldiers, spelter soldiers. And it produces with copper the imitation of gold, called pances metal, the zinc giving a yellow colour to the copper, though it is white itself. It does not diminish the ductility much, resembling gold in appearance and colour. It has such a toughness and ductility as to be beat out under the hammer, and to be drawn into very fine wire, and has a certain consistence rendering it a better material for workmen; and being less tough than the copper, it is easier made into a variety of shapes, and has farther the advantage of bearing better the effects of the air. The preparations of copper and zinc, to produce the exact imitation of gold, have been considered by several chemists, and it is found that nearly an equal weight is necessary; but unless they are fine, they produce a brittle metal. The copper must be refined by means of lead from sulphur and arsenic, which adhering very strongly to the copper, it forms a very brittle composition. Many manufacturers pretend to secrets in this way, and to produce better compositions than ordinary.

## DCCXXX.

With regard to the origin of the metal, for a long

time we were supplied only from two sources, the East Indies and China; the only other place was from Germany, from a particular ore at Ramelsburgh. We had no account of the process used in the East Indies, but the process used at Ramelsburgh was pretty well known. The ore is wrought chiefly for silver, but there is a large proportion of lead, and besides there is a quantity of the ore of zinc. In working this compound ore they melt it in the usual furnace. Having a quantity of loose charcoal at the bottom, the lead runs down to a cavity, defended from the action of the heat and air, that it may be burnt. In the furnace, or tower, in which the fusion is performed, there is opposite to the nasal of the bellows the opposite wall of the furnace, composed of two thin stones, one next to the fire, the other next to the external air, and a cavity between them; for there is a thin partition formed between the tower and the external stone, on the front wall is double. That part of the ore containing zinc is by the heat and contact of the fuel reduced to its metallic state, and being converted into vapours, these are drawn forwards towards this partition, through the interstices of the stones, into the cavity in the middle of the wall, and the external partition which defends them from the external air, is kept cool by throwing water upon it, the steams are condensed, and after a day or two, or more, such a quantity of zinc is collected, that it is worth while to take it out; so in this way a sort of distillation of the zinc is carried on.

## DCCXXXI.

This was the only place where zinc was obtained in Europe, although the ores of it were sufficiently known

as such, from their effect in making brass. They contain the zinc in the state of an oxyd, and form masses of different degrees of hardness. They are generally of a yellowish colour, some resembling a stone; so commonly called lapis calaminaris, or calamine stone. This has been long employed in the making of brass; and considering the effect of the zinc in this way, they concluded that it was the ore of this metal. The calamine is generally separated from sulphur adhering to it, or other ores mixed with it, then it is ground to powder, and mixed with a quantity of charcoal dust, and put into pots or crucibles; over this are laid plates of copper, then over these more of the mixture, stratum super stratum; and a number of vessels, charged in this manner, are put into a furnace, and the heat is raised so as to bring the brass into fusion. The furnace is then allowed to cool, and they find the copper converted into brass, and it is found to have increased  $\frac{1}{3}$  of its weight during the process.

## DCCXXXII.

*Lead.*

We next come to lead, which is the softest of all the metals: it is so totally void of elasticity, that it produces no sound, when struck. But though it is remarkably soft, it is generally least ductile and malleable; it cannot be beat into thin leaves, or drawn into fine wire. It has but a small cohesion of parts: its fusibility is well known. It is also volatile in that degree of heat which makes it calcine fast, if the free air is admitted. When it is passing from its state of fluidity, it passes through a particular state, in which it can be easily divided into small particles; cooling it gradually, and stirring it with a stick, the parts cohere like wet sand; and stirring it briskly, it

is divided into particles, like seeds, and this is called granulation. This is sometimes managed by having an oval wooden box, the middle of which is rubbed with chalk; the melted lead is inclosed in this, and shaken violently, and a quantity of it is reduced to these grains; but the process succeeds better in the other way, when it is put into an iron mortar, which cools more slowly, and allows more time for dividing its parts, when it is in that particular state of cohesion.

## DCCXXXIII.

The manner of making it into shot is sufficiently curious. It is made to run through an iron cylinder into a quantity of water, to which a little arsenic or orpiment is added, which disposes it to assume the form of round drops, but only a number of them are round, the most of them are in the form of pears, conical; these are separated by making the whole run down an inclined plane, they running to a side. The shot is afterwards divided into different sizes, by means of iron sieves.

## DCCXXXIV.

This metal is very calcinable in a heat a little above that necessary to its fusion. When it is merely kept melted in the fire, it is soon tarnished, a pellicle is formed, or imperfect oxyd; and drawing this aside, and exposing a fresh surface to the air, that in like manner becomes tarnished, and so we can form the whole into a drossy skin. It is thus formed into a kind of grey or green coloured powder, which is an imperfect oxyd of the metal. The lead is oxydated more quickly, in the way of scorification, by a stronger heat; it collects into a drossy cover over the lead, and unless it is separated or blown off, the scori-

fication does not proceed very fast. Great quantities of lead are changed very often, in a process of this kind, in the operation of separating silver from lead. There are few lead ores which do not contain some silver; so the lead is separated by scorification, and the silver is not oxydated, but remains in its metallic state entire, when the lead is calcined.

## DCCXXXV.

The process in this large way is managed by heating the lead on a hearth, till it is heated to the scorifying degree; by means of two pairs of bellows, the air is directed on the middle of the surface of the melted lead, which makes it scorify very fast, and at the same time the scorified parts, or melted litharge, is blown off towards the opposite side, where there is a channel to conduct it out of the furnace, otherwise it would cover the surface, and defend it from the action of the air, and thus it is had in shining scaly particles, of a reddish colour. When it is allowed to cool in rest and tranquillity, it forms a solid mass, having a yellowish colour; the internal texture resembles some of the talky bodies and antimony, zinc, or bismuth. It is composed of plates, assembled together in crystallizations, and it is called litharge.

## DCCXXXVI.

This oxyd does not suffer much change from the action of heat and air alone. It is volatilized till it totally disappears; but it changes its appearance greatly, when oxydated with a reberated flame of wood. It is reduced to a fine powder, and exposed on the sole of an oven, so that the flame may be beat down by the arch, so as to play upon the surface, the vent being in the opposite

side of the oven, called masticott. This changes its colour gradually to an orange, and ends in a pretty bright red, and it is called red lead, or minium. This requires two or three days; the calx must be frequently stirred, and care taken that the heat be not raised too high, so as to bring it into fusion, otherwise it loses the red colour, and forms litharge. All these calces are very fusible, though not so much so as lead itself.

## DCCXXXVII.

We have also the litharge auri et argenti. The litharge auri is more of a yellow or orange colour, and is generally produced in the process for extracting silver from lead, the heat being raised by the flame of wood, which gives it a little of the orange cast. In other cases, where the heat is produced by means of other fuel, the litharge is more of a whitish colour, retaining some of the lead intermixed. But these terms are now laid aside, as there is only one sort of oxyd of lead, and the colour depends only on the circumstances of the oxydation.

## DCCXXXVIII.

The calces of lead easily return to their metallic state, by melting them with  $\frac{1}{2}$  part of their weight of coaly matter. Thus when we burn common red wafers, which are made of some kind of paste, coloured with red lead, if we set fire to them, after the most volatile parts are dissipated, while the charcoal is burning, little drops of lead form.

## DCCXXXIX.

These oxyds are also revived by their fusion with some other metals, as iron, &c. If litharge is melted with



filings of iron, the most part of it is restored to its metallic state, and most part of the filings are scorified. From this is understood the use of the grease, and other oily substances, used in melting lead, grease, tallow, or resin, when the surface becomes bright again. These substances act partly by absorbing the oxygen of the calx, making the metal return to the form of lead. They easily endure the degree of heat sufficient for melting the lead; and being lighter, they always keep at the top, and prevent the action of the air.

## DCCXL.

Lead has a strong attraction for the sulphuric acid, with which it forms an insoluble compound, and added to a solution made by other acids, it precipitates them, and forms a similar compound; and this not only happens when the pure acid is added, but when a salt is added, which contains it in however so small a quantity, a proportional part precipitates; so a solution of lead in other acids is a very nice test of the vitriolic acid in mineral waters. So when there is added to water, containing a solution of lead, the most minute quantity of the vitriolic acid, a turbidness ensues, and precipitation. This does not take place with the nitrous acid, and the same thing happens when the compounds of this acid with the fixed alkalies are used. But though the vitriolic acid shews such a superior attraction for lead dissolved in other acids, it acts slowly on the lead, except as an oxyd.

## DCCXLI.

The nitrous acid, or aqua fortis, is the most ready solvent of this metal; it produces a perfect solution with moderated effervescence. The solution can be reduced

to the form of a dry salt, or nitrat of lead, affording white crystals.

## DCCXLII.

The muriatic acid forms a white oxyd, which has a moderate degree of solubility in water. It unites with the lead more readily, by adding any neutral salt which contains the muriatic acid, to a solution of lead in the nitrous acid; thus a precipitate of the lead and muriatic acid is occasioned. The muriat of lead, exposed to a moderate heat, melts into a transparent horn-like matter, called *plumbum corneum*, from its similarity to a compound produced from silver, which melts in the same manner, proves transparent and flexible, and is so soft as to be cut with a knife like a horn; so from its resemblance to horn in these particulars, it has been called *argentum corneum*, and its only remarkable quality is a powerful astringency; it is the most powerful astringent substance of any to be met with.

## DCCXLIII.

The other acids act chiefly on lead, in the state of oxyd. They act especially on a rust of lead, a particular oxyd or corrosion formed by means of the vegetable acid itself. This preparation is much used in some of the arts, and is well known under the name of white lead or *ceruss*. It is obtained by exposing plates, in close distilling vessels, to vinegar, which is kept constantly rising in steam. The plates are soon covered, to a considerable thickness, with this corrosion, which starts off on the lead being unfolded; and this being reduced to a fine powder, is called white lead. It is chiefly from this sort of corro-

sion the combination of the vegetable acids with lead are obtained.

## DCCXLIV.

The ceruss, digested with vinegar, communicates a sweet astringent taste to it, and takes off its acidity. The solution being evaporated, affords a salt which readily dissolves in water, and from its sweetish taste is called *saccharum saturni*, or *cerussa acetata*. When it is desired to have it in more solid crystals, it may be dissolved with more vinegar, and evaporated again, whereby a greater quantity of oxygen is combined with the lead, and forms a more soluble crystallizable salt.

## DCCXLV.

All the oxyds of lead are easily decomposed by the application of alkalies, or absorbent earths. Thus the solution of lead in the nitrous acid, diluted with water, is rendered turbid, by the smallest quantity of alkali, or calcarious earth.

## DCCXLVI.

The effects of alkaline salts upon lead are not different from these they produce on the metallic substances in general. Melted with lead they dissolve or corrode a part of it, especially in their caustic state, and nitre calcines it in a proper degree of heat, converting it into litharge; and as the proportion of nitre is but small, there is no considerable deslagration.

## DCCXLVII.

In the history of most other metals not much is to be said with respect to the earths; but this is not the case with respect to lead. One of its most distinguishing or

useful qualities is a power which its oxyd possesses of melting, or dissolving more or less readily, all the earthy substances, without exception, uniting with them in the form of a glass. It has this property in so eminent a degree, that no vessels can confine it, for any time, in the fire; and as it is employed in metallurgical operations, it is usual to mix it with earthy matter, to abate this dissolving power, and it is called glass of lead; being two or three parts of litharge with one of flinty matter, which rather exceeds the litharge in bulk.

## DCCXLVIII.

The most proper materials to mix with lead, in these cases, is the purest kind of clay; and as it is necessary to add some dividing substance, the use of burnt clay is recommended, beat into a powder, like sand, and mixed with the fresh clay. But still such crucibles contain the oxyd of lead for a long time, only, for they are dissolved at length. The reason why the chemists have shewn such a desire to discover proper vessels, is an opinion which has prevailed among them, that lead by repeated fusion and reduction may be converted into silver. In consequence of this supposed quality, this metal is much employed in the treatment of gold and silver, &c. These metals are melted with a large quantity of lead, and part scorifying brings the ore into fluidity, and the metallic part separates, and mixes with the lead at the bottom, and the lead is easily separated by scorifications.

## DCCXLIX.

It is much employed also in the composition of the finer kinds of glass, from its dissolving the earthy substances so readily, especially the flinty earths, with which,

in certain proportions, it forms a fine glass, the lead giving it a greater degree of transparency, rendering it more void of colour and more fusible. It continues flexible and tough in the lowest degree of red heat, so it is easier to work and finish the glass. The common glass, which is called flint glass, contains a large proportion of lead, which is easily extracted from it; and when such compositions are made with particular attention and nicety, a glass may be formed of remarkable brightness and transparency, resembling the diamond paste so much that good imitations are made of the precious stones, called pastes. These are made of the purest kinds of the flinty earths with refined fixed alkali, borax, and the calx of lead. The use of the calx is to communicate to the glass a power of dispersing the colours of the light. Transparent bodies have two effects on the light; one is refraction, a bending of the ray out of its course on going into, and in passing through it, it is bent towards the perpendicular of the surface. But besides, they separate the colours of the light from one another, so that after two or three refractions it is converted into different colours, and lead gives it more of the colour which is so remarkable in the diamond. No matter has so much power in dispersing the colours of the light as the diamond, and these pastes have it to a very great degree. This sort of glass is not used for mirror plates, as it is never very equal in density, which occasions an irregular refraction of the rays, and thus forms the phenomenon which is called eels, as in the stoppers of decanters, where the parts are of different degrees of thickness or density, in consequence of their containing more or less of the

calx, the parts which are uppermost losing a little by evaporation.

## DCCL.

When the calx of lead is very redundant, and not highly calcined, it communicates a yellow colour, which is produced in the glasses, made to resemble the topaz, &c. and it is called the glaze of the lead. The glaze of the common kind of earthenware is of the same kind; it is made by a rude kind of vitrification; the ore of lead is dusted on the surface of the ware, or a mixture of minium with the flinty earth is used, and the heat applied to the ware proves sufficient for vitrifying, that making it act upon the surface of the ware; and as the degree of heat is not very strong, the glaze has always a yellow colour. The lead is easily recovered from such glasses, it need only be reduced to powder, and melted with a small quantity of charcoal dust, or an alkali may be added, to bring the earthy matter into fusion, so as to allow the particles of the lead to settle to the bottom; and it may in like manner be recovered from glass which contains a small quantity of it, as the common flint glass. Hence this sort of glass which is employed in making the tubes of barometers and thermometers is liable to be smoked or blackened with the flame of the blow pipe, and it requires skill to seal up the tube without making it opaque.

## DCCLI.

With respect to the inflammable bodies, the oily substances, without exception, dissolve lead, and there are none of these which dissolve it more perfectly than the fixed or unctuous oils. The dissolution of the oxyd in these oils, requires the assistance of some heat, as that of

## DCCLIV.

Oils also are sophisticated by this means, when they grow rancid; a quantity of lead dissolved in them corrects the bad quality: but such oils, mixed with a solution of sulphur, are changed in their colour, in like manner as the wines.

## DCCLV.

It is for the same reason that the oxyds of lead are liable to a great inconvenience, as a pigment, particularly the white lead, when used in water colours. They seldom retain their whiteness, especially if they are in the neighbourhood of corrupted animal or vegetable substances; they acquire gradually a dark colour from sulphurated hydrogen gas.

## DCCLVI.

With respect to the other metals, it is mixed with them all, except iron and cobalt. Of this last it dissolves a small portion, but the rest remains disunited. It mixes with all the rest, increases the disposition of all the other metals to scorification; so on this is founded the methods of separating the other metals from gold and silver; a large quantity of lead is added, which being scorified, the other metals are oxydated, and the gold and silver, which resists the heat and air, remain at last pure.

## DCCLVII.

The ores of this metal are among the most plentiful of any, particularly in this country, and are not of any great variety; the only ore is what is called the gold of plumbi, a compound of lead with sulphur. When it is pure, and in large quantity, it breaks into rectangular

masses ; on other occasions it is found not of so regular a structure, the grain being more confounded by an admixture of arsenic, and perhaps antimony. When it is found in thin veins, it is composed of small masses, but these break much in the same manner into rectangular particles ; this is called a steel grained ore ; the particular appearance depends upon the thickness of the ore, the ore having been disturbed in its crystallization by the neighbourhood of stony matter with which it is surrounded. In the veins of these ores there are some varieties met with which are only accidental, though these varieties are found in some of the veins of this country which are very rich of lead, particularly in the white lead ore, which is an oxyd of the metal. It crystallizes into oblong crystals, composed of fibres, having a silvery shining appearance, resembling the crystals of salts. Sometimes they are found tinged with various colours, from the additions of some earthy matters in their formation. Some of these white crystals are sometimes united together, but very loosely, as this occurring in the cavities of veins.

## DCCLVIII.

There is a noted ore of lead which is green ; this often forms a crust upon the stone, or other mass of ore, the surface of which is formed into a number of protuberances. It is difficult of reduction, and appears to be an oxyd of lead, combined with a quantity of muriatic acid. Others are of a yellowish colour, from a small quantity of the oxyd of antimony.

## DCCLIX.

The manner of extracting the metal is simple in this country. Abroad, where the ore is impure, and mixed



with pyrites and a great quantity of sulphur, this occasions a great loss of the lead, so that they must roast the lead ore, in order to dissipate the sulphur, and the pyrites is burnt into red ashes, containing an oxyd of iron, which can be washed off with water. But when the ore contains nothing but sulphur, it is melted immediately in a particular furnace, in which the heat is but very moderate, but which is sufficient to the air to dissipate the sulphur, and make the lead melt into its metallic form.

## DCCLX.

*Tin.*

The next metal that falls to be examined is tin, the external appearance of which is well known. It has a whiteness resembling that of silver, in its pure state, and the purest form is called grained tin. When we break a large mass of it, in its cooling state, it divides into long fragments. It is one of the softest metals, and has a great degree of malleability; but it is not ductile into wire. It has one particular quality, it produces a crackling noise when it is bent, probably owing to some impurity; and touching it with our teeth, our sense of hearing is rendered more acute, by the vibration communicated to the bones of the head. It is more easily melted than any of the perfect metals, and passing again to a state of solidity, it undergoes a particular state of cohesion, like to that which lead passes through. In consequence of this it can be reduced into small grains. It is also easily oxydated in an obscure red heat. When the heat is raised to a certain degree a grey powder is obtained, and in a still stronger heat this powder becomes white. Its oxyds are not in the least fusible. There is indeed

one way of producing the glass of tin : we put it into a crucible, the upper surface is oxydated; and the under portion retains its metallic form; the middle one is in a state of imperfect oxydation, or in a state resembling glass.

## DCCLXI.

By the action of the different acids it is also easily oxydated. The sulphuric acid oxydates it without dissolving it, and the sulphurous forms with it a sulphurated sulphate of tin. The nitric acid precipitates it in a white oxyd, but the tin is not dissolved. This oxyd is perfectly infusible, and it is with difficulty reduced to tin again. A nitrate of tin is obtained by the nitrous acid diluted, and applied cold.

## DCCLXII.

The nitro muriatic acid, or the aqua regia, dissolves the tin, if the metal is put in slowly, and forms a solution of a transparent colour. The manner of making that solution has been much studied, as it is necessary in forming a particular precipitate of gold used in enamel painting, and it is necessary to the dyers of scarlet, for changing the natural colour of the cochineal into a red scarlet; but if the metal is put in too hastily, or is not kept very cold, it is so much oxydated that it will not dissolve in the other acid; so the whole art is to keep the liquor cool, and to add the tin slowly, when we have a solution that has the qualities for the purpose. The best proportions of the liquor are two parts of nitric and one of muriatic acid. This solution of tin is also used for precipitating gold from aqua regia, for colouring glass.

## DCCLXIII.

The muriatic acid dissolves tin, cold or heated, pro-

ducing a muriat of tin; but the oxyd is imperfect, and absorbs more oxygen, if presented to it. A particular preparation is the oxygenated muriat of tin. Thus mercury sublimate being mixed with powdered tin, the acid quits it, and forms a compound like the butter of antimony, but it is more fluid and volatile. It emits copious white vapours, so it is called the smoking liquor of Libavius. It is highly corrosive, similar to some of the other compounds of the muriatic acid.

## DCCLXIV.

The vegetable acids have little action upon tin, in its metallic state. They oxydate it a little; but it is employed to defend the surface of some other metals which are more easily affected by vegetable fluids.

The neutral salts act upon it, both in its metallic and oxydated state.

## DCCLXV.

With vitrified earths the oxyd of this metal constitutes the white enamel with which the dial plates of watches are covered. They are made of a tender and fusible glass, to which the oxyd of tin is added, which not being fusible, gives a beautiful whiteness to the glass.

## DCCLXVI.

When combined with sulphur it forms a dark coloured matter, which is not so fusible as tin, but the compound is different, according to the oxydation of the tin. Thus without its oxydation we have a mass consisting of sparkling particles; when oxydated we form a curious product, a compound called aurum mosaicum, or sulphuret of tin. It is a substance composed of very beautiful flaky par-

ticles, which are very light, so as to float in the air, and rubbed between the fingers and thumb, it seems smooth and slippery, and has a pretty bright golden colour. This product is obtained by uniting the sulphur to the tin, in a particular manner. The process commonly used is to mix together sulphur and tin. The tin, (12 ounces) is divided by means of mercury, (six ounces,) which renders it a brittle amalgam, so that it can be reduced to a fine powder; to this is added a quantity of sulphur, (seven ounces,) and some muriat of ammonia, or sal ammoniac, (six ounces,) and the mixture is sublimed. This production, rubbed on other bodies, gives them a gilded appearance.

## DCCLXVII.

Tin unites with all the other metallic substances, though it is ductile itself, and can be beat out into plates or leaves. It totally destroys their malleability; so gold has its toughness destroyed by such a minute quantity of tin, that the goldsmiths use the utmost caution that no tin even approach the furnace, as the very vapour of that metal is sufficient to render the gold more brittle.

It is added to copper or brass in considerable quantity, to give elasticity to them at the same time that it gives brightness to them: so the metal of bells is of this kind.

## DCCLXVIII.

The other useful mixture is pewter, which consists of tin alloyed with a quantity of lead, and in some countries the alloy of lead is regulated by law. Block tin, or tin in a pure state, is employed occasionally, on account of its whiteness, resembling that of silver; and zinc is sometimes added, which renders it hard, and at the same time

remarkably white. Some of these mixtures have a great degree of fusibility. It is a general rule that the metallic mixtures have a great degree of fusibility, and that they are more fusible than the medium fusibility of the metals entering into their composition. This is the case with regard to the mixtures of tin, to such a degree that the metal can be compounded, which is more fusible than any metal we know, and will become perfectly fluid with the heat of boiling water. It consists of five parts of bismuth, three of tin, and two of lead. When we pour boiling water upon this mixture it becomes soft, and keeping the water boiling it becomes fluid; so it has been proposed as a proper mixture for anatomical injections. It was supposed that it might easily be thrown into the vessels of the different organs, that the animal matters being discharged by putrefaction, the metal would be left moulded by the vessels, but the experiment does not succeed. It has too a considerable degree of hardness and toughness, and the degree of heat necessary is the pure heat of boiling water, or nearly that. Below that heat the metal is not fluid, and animal substances do not bear the full heat of boiling water without being corrugated and contracted, whereas in order to inject an organ, they macerate it in tepid water, in order to relax the vessels as much as possible.

## DCCLXIX.

With regard to the ores of tin, it is rarely found pure; and in its metallic state it is yet in the form of an ore combined chiefly with arsenic, and concretioned into hard masses of a deep yellow colour, with some transparency. These are called tin grains or crystals; they are generally

intermixed with a considerable quantity of stony matter, and other materials; often intermixed with a flinty earth or quartz, and with the stony substances called churl. Sometimes it is mixed with an ore of iron, and is reddish, and this is reckoned a less valuable ore. There are separate grains found in the gravel of brooks, where the rubbish of mountains is washed down, and a stream of water washing away the lighter gravel, leaves the grains of tin ore, which the people gather up. These are remarkable, as being one of the heaviest of the mineral substances, containing the tin combined with arsenic, and at the same time these crystals are very hard, so it is one of the metals upon which the practice of elutriation is the most successful.

## DCCLXX.

All these ores of tin are pounded down to a meal, which is washed carefully to get rid of the stony matter, when it is successfully heated. It is necessary, previous to its fusion, that it be roasted, in order to dissipate the arsenic as much as possible. If it contains any pyrites it is soon brought to a red colour, so as to leave the grains of tin free from iron and sulphur.

## DCCLXXI.

*Iron.*

From tin we proceed to a metal of more importance, iron, which possesses a combination of properties that have made it a noble substance for the ingenuity of man to work upon, from its hardness, its toughness, and the strong cohesion of its parts, which can be modified so as to have either toughness and hardness, or a middle state of elasticity. To these if we join the great softness

it acquires when heated to a certain degree, which enables us to form or fashion it, and the disposition the different parts of it have to cohere, when heated, to one another, which also facilitate the formation of different instruments, we shall have all the qualities in consequence of which it is so useful. Examined in its cold state it is considerably obdurate and rigid under the hammer, but it is capable of being drawn into very fine wire, as some harpsichord wire, which is very small.

## DCCLXXII.

It is the only metallic substance which is affected by the magnet, as it is not only affected by that natural stone, but it is capable of being changed into magnets, acquiring the magnetic quality in a very great degree. The process for this is very curious, and among the most extraordinary and unaccountable processes in natural philosophy. Bars of steel, hardened to the greatest degree, are laid at one another's ends on a table, other bars are then laid in certain positions with respect to the former, they are rubbed upon one another, then the bars are changed, and the operation repeated till they become powerful magnets.

## DCCLXXIII.

The chemists have taken advantage of this power, to purify iron filings from other metals, &c.; and to prevent the magnet from raising them in great bunches, it is proper to spread on the top of them a piece of fine gauze, or the bottom of a sieve; and by means of the magnet to draw up the filings through the gauze, and thus we can have them quite pure.

## DCCLXXIV.

This metal, in its most ductile state, is hardly capable of fusion in close vessels: in its more crude state it is more easily melted. Pig iron runs down from the ore, is melted without difficulty in a violent fire, and even tough iron heated with gypsum, in the way of cementation, can be rendered fusible; but taking it in its tough state, it is perfectly infusible in close vessels, when heated to a violent degree; however it is very soft, and in that state different pieces can be made to cohere. The blacksmiths, when they practise this, throw into the fire a small quantity of sand, or a bit of free-stone composed of sand; this melts on the surface of the iron, when the surface shines like glass, and by a stroke of the hammer they come into perfect fusion: so the use of the sand is to keep back the scorix in a state of fluidity, that it may separate immediately when the two pieces are applied, and allow the pure iron to come into contact; and it is as little an obstruction as if it were water, or any other fluid: so the sand answers the same purpose for welding as the borax does in foldering the other metals.

## DCCLXXV.

When iron is suddenly cooled after it has been violently heated, it is harder and less pliable than before. When exposed to a moderate heat it undergoes a slight degree of oxydation, and the first phenomenon is the appearance as of rainbow colours, which succeed one another when the iron is approaching to a red heat. So if a polished rod of iron is put with one end into the fire, that it may be heated gradually, the part at which the heat enters becomes of a yellow colour, assumes a gold or orange colour, then



appears purple, then of a violet colour, then ends in a deep blue, and when heated still farther, the blue is weakened, when beginning to be red hot. On the rod of iron we can observe all this; at the end next the fire we have the colours produced by the greatest heat; and farther on we have the colours produced by the less degrees of heat; and if the iron is made of a dull red heat, the oxydated matter increases in thickness, so as to form a grey matter of an earthy appearance. When the iron is suddenly plunged into water, the oxydated part can be made to fly off in the form of a scale; so the colour depends upon an exceeding thin oxydated pellicle, which reflects certain of the rays of light, and no other; but when it has arrived at a certain degree of thickness, it absorbs them entirely, and appears of a dark grey colour.

## DCCLXXVI.

This part ground to a powder, when exposed long to the action of heat and air, is changed to an oxyd of a deep purple colour, which is the natural colour of the oxyd of iron. The oxyds of iron being either purplish or of a yellow colour, are called *croci*, the yellow prevailing in the greater number.

## DCCLXXVII.

The oxyd is easily restored to a metallic state, so far at least as to bring it under the power of the magnet, and to give it a dark colour, by mixing it with oil, or tallow, or charcoal dust, and keeping it red hot for some time.

## DCCLXXVIII.

When the iron is oxydated to a certain degree, the

magnet has still some power over it; but when oxydated still farther the magnet loses its power. Upon this is founded the method of detecting small quantities of iron mixed with earths and other matters: and in the ashes of most animal and vegetable substances, when they are kept red hot with inflammable matter, the magnet attracts small particles which are found to be iron, though it requires an intense heat, and it is difficult to succeed in this.

## DCCLXXIX.

Iron is dissolved and oxydated by the several acids, and it is also oxydated, at a low temperature, by exposure to the air. Hence it has been a desideratum to preserve iron from rusting. The most successful methods are to apply different varnishes of the oily kinds, particularly the drying oils, lintseed, walnut, &c. To these are added a small quantity of lead; some of the calces of this metal are dissolved in them, which hastens the drying, and increases the thickness of the varnish. Others add different resinous substances; but one of the most simple means is practised in the works where much iron is manufactured, where axes, &c. are made. They have a vessel with lime and water, with which they wash the utensil, and then throw it aside; the water evaporating leaves a small film of calcarious matter, which proves a varnish or defence from the injuries of the air for some time after. If iron is heated till a thin oxydated crust is formed upon it, it will preserve better from rusting in that state: so many nice works are heated to such a degree as to form that thin blue film, or oxydation, as the springs of watches, &c.

## DCCLXXX.

To dissolve the iron, the sulphuric acid, when concentrated, requires the assistance of a boiling heat ; but when diluted to three or four times, the solution proceeds rapidly in the cold. By this solution a large portion of hydrogen gas is disengaged, having a heavy disagreeable odour, which is perceived when the steams have diffused themselves through the room ; a constant flame is perceived also at the mouth of the vessel. When the solution is completed it turns out a liquor of a pale green colour, which by evaporation affords crystals which are green, especially when fresh. They are of a pleasant light green colour, but when kept some time they are liable to become yellowish. This is the substance called sulphate of iron, or green vitriol. It is not produced for ordinary purposes in this manner ; it is obtained much cheaper from pyrites. It contains a great quantity of water, fully the half of its weight, so undergoes the watery fusion, and the compound of iron and acid remains behind in a white concremented mass. Increasing the heat further some of the acid begins to evaporate, and leaves the iron in the form of a reddish calx, and there is always some little loss of the acid, which gets away with the water. Increasing the heat farther, more of the acid evaporates, and the oxyd of the iron is of a deeper colour. And still farther increased to a red heat, the acid is totally dissipated, and we have an oxyd of the iron, of a deep red colour, inclining to purple.

## DCCLXXXI.

Nitric acid immediately attacks iron with violence, and is raised in red vapours, or nitrous gas disengaged.

In order to have a perfect solution without diluting the acid, when its operation is slow, the solution is kept as cool as possible, by putting the vessel in a quantity of cold water; and further, the iron is added but slowly, that the acid may not grow hot with it; so we do not put in filings which have such an extensive surface. We have iron wire broken into little bits, and put in only one of these at a time. It acts with a moderate effervescence, and the acid is gradually tinged of a gum colour; this colour increases till the acid is saturated, when it assumes a pale yellow colour. When the solution is formed with less caution from the beginning, it turns out of a brown rusty colour, as we generally add a little water to the glass, or dilute the acid in which the iron filings are dissolved. None of these solutions give any crystals before they become dry. Nitrous gas is copiously disengaged during this process, and the iron is left in the state of an oxyd.

## DCCLXXXII.

The muriatic acid also dissolves iron readily, and produces a moderate degree of effervescence, somewhat in the same manner as the sulphuric does, which is attended too with the production of hydrogen gas, having the same heavy offensive smell. This solution too turns out of a green colour; by proper evaporation it affords crystals like the sulphate. This acid has also a remarkable power over the oxyds of iron, dissolving these more readily than other acids. When it acts on the oxyd of iron, the solution turns out of a yellow colour. It has often imposed upon ignorant chemists, and made them imagine they had discovered gold in different minerals, in which however there is not the smallest atom.

## DCCLXXXIII.

The solution of gold in aqua regia has precisely the same yellow colour with that of the oxyd of iron; so applying the muriatic acid, or aqua regia, and getting a solution of that colour, they persuaded themselves that they had found gold; but finding it not possible to reduce it to its ordinary form, they called it volatile or imperfect gold, still carrying on the imposition, and going on with a number of experiments to extract it more fully.

## DCCLXXXIV.

The vegetable acids act upon iron, and dissolve it gently and slowly. The acetous acid has little attraction for the oxyd of iron; in its metallic form it produces a green solution. Tartar dissolves the oxyd better, especially an acid of tartar, and there are some particular preparations of this kind, as the martial balls, &c.

## DCCLXXXV.

If these preparations are largely diluted, they are liable to deposit a part of the iron in the form of a tender oxyd or mud, of a yellow or reddish colour, which is commonly called ochre. This deposition we find in the neighbourhood of mineral springs, as soon as the water is exposed to the air and attracts oxygen, a portion of the iron is deposited, and though the quantity of this metal in a given quantity of water is very small, where the water is running constantly it comes to accumulate at last: so water, which can be hardly made to show any iron, will be made to exhibit a considerable appearance of ochre in the channel which the waters form.

## DCCLXXXVI.

The durable yellow stain which the solution of iron, used in printing, gives, is owing to an oxyd. The iron, dissolved in vinegar, is introduced into the cloth, and deposited in the form of a powder, which cannot come out so long as it retains the form, until it is dissolved: so the proper way of removing this is by applying an acid, to bring the iron into a state of dissolution. The muriatic acid is used for this purpose, being the most powerful dissolver of the oxyds of metals, while the sulphuric is more corrosive, and the nitric renders the oxyd more difficult of solution. The acetic acid does not answer, but the acid of sorrel or oxalic is sold for the purpose, and answers very well.

## DCCLXXXVII.

The alkalies precipitate the iron in the form of an oxyd of a bluish grey colour, which precipitate attracting oxygen from the air, changes its colour, assuming the ordinary colour of the oxyd of iron, viz. that of an ochre. In most cases it is partly, and in some cases the precipitate of the iron can be wholly re-dissolved, by adding a large quantity of the alkali. To do this, in the best manner, it is proper to use the solution of iron in the nitrous acid, which forms with fixed alkali the solution called the tincture of iron, or the alkaline tincture of iron.

## DCCLXXXVIII.

The appearances of these preparations depend on the degree of oxydation. Upon dropping into a clear solution of iron a solution of an alkaline salt, there is an effervescence, and the iron is precipitated in the form of

a reddish mud ; but stirring the mixture, it will be redissolved, and will tinge the fluid of a deep red colour, of as fine and rich a red as that of blood. .

## DCCLXXXIX.

One of the most remarkable effects upon iron is that which occurs in the preparation of Prussian blue. The iron, in its combination, appears in the form of a blue substance, the colour of which is exceedingly rich and deep, or commonly at first it appears of a grey or greenish colour, and becomes blue upon adding a small quantity of muriatic acid. The most minute quantity of iron can be discovered in a mixture, by the addition of the Prussic acid. The iron gives an exceedingly faint yellowish tinge to the liquor ; and dropping in some of this preparation, the liquor immediately assumes a pleasant bright blue colour, which will be made richer and deeper by dropping into it a small quantity of muriatic acid. When the experiment is made with a solution of iron, the mixture appears as a tincture ; but there is a precipitation of the iron, as appears when it stands at rest ; the liquor becomes colourless, and the *fæcula* remaining is not soluble in any acid.

## DCCXC.

The foundation of the process for the pigment called Prussian blue was first the effect of accidental discovery. A chemist had emptied all his glasses upon the floor, and found a beautiful blue produced ; and recollecting the materials, and making experiments, he discovered its formation : he kept it a secret, and made a very great profit of it. It is now a colour much valued by painters : it is used in preparing white linen for the market, and was first used at Berlin.

## DCCXCI.

The process consists in mixing equal quantities, as four ounces of fixed alkali and bullocks' blood, and the mixture is exposed to ignition in a covered crucible. By this means a coal is obtained, which is exsiccated, filtered, and concentrated by evaporation. Another solution is made of two ounces of sulphate of iron and four ounces of sulphate of alumine, dissolved in a pint of water; and the two solutions being mixed, a bluish deposition falls down, the colour of which is increased by washing it with muriatic acid.

## DCCXCII.

Another particular preparation which comes to be noticed here, is the effect of astringent vegetable substances upon all solutions of iron, from the action of the gallic acid present in them. By astringent vegetable substances is meant those which applied to the animal fibres have an effect of shortening and hardening them, and applied to the tongue have a particular roughness. These qualities are predominant in some particular vegetables, as in the different parts of the oak, in the galls and leaves. We find the same qualities in the flos, and there is a considerable quantity of it in common tea. This mixed with iron produces a black tincture, which is so deep that a small quantity of iron, and of this matter, dissolved in the same fluid, will discover one another, producing the tinge which is very perceptible; and this proves another nice test of the presence of iron in mineral waters and mixtures. To shew this experiment we may dilute some of the solution of iron, and then drop into it a small quantity of galls, reduced to powder. These arise from the oak in consequence of an evaporation of the



fluids of the tree, occasioning a protuberance. As soon as the astringent substance is diffused through the solution, a black tincture is produced, which will descend downwards through the fluid, till the whole acquires a black colour. When the galls have infused themselves, they communicate a pale yellowish colour; and if the solution is applied to iron, it will dissolve enough to become capable of a black tinge; and if a knife is laid upon mahogany, or other wood, and if any water, or other fluid, happens to touch it, it is common to see a black stain produced from the action of the gallic acid, which gives the black tinge. In like manner, a little of the infusion of tea dropped on a knife will produce a blackish stain, the tea containing a quantity of this acid, which dissolves enough of the iron to strike the black tincture.

## DCCXCIII.

The experiment has also been made the foundation of a trial for distinguishing true brandy from counterfeit. Some time ago it was required to carry a small quantity of the solution of sulphate of iron about with one, and to drop some of it into the spirit: if the brandy was true it acquired a black tincture; but this experiment proceeded on a mistake that the black colour depends upon the genuineness of brandy, whereas it depends upon a tincture the brandy receives from the cask: so it may be considered as a proof of old brandy. But the dealers in spirits, understanding the foundation of the black tincture, have contrived a method for eluding this trial. They prepare spirits, to which they give a flavour, and infuse oak shavings, which give the yellowish colour, and the liquor will strike a black colour or tincture

with the solution of iron, in the same manner as that which has received the tincture from the cask.

. DCCXCIV.

On the same principle has been founded the art of dying black, and the composition of the ink now used for writing. The striking a black colour upon silk, woollen, linen, and cotton, depends upon a mixture of iron with vegetable matter, either applied at the same time or in succession. In staining of leather the application of a solution of iron is sufficient, as during the preparation of tanning it is imbued with a quantity of the gallic acid: so a solution of iron stains it of a deep black.

DCCXCV.

In the composition of ink the chief ingredient is iron, combined with an acid, and a quantity of astringent vegetable matter; and as the excellence of ink and the durability of writing is a point of consequence, and interesting to mankind, several chemists have made it an object of their inquiry to ascertain the best composition. The ingredients found essential to the composition, and to produce the effect desired, are sulphate of iron, galls, and gum arabic. Different persons have different processes; but the best proportion of the galls and iron is mixing them together in equal quantities. The ink is thus at its blackest colour; but in this proportion the ink does not prove durable: on being kept and exposed to the air and light, it soon fades. So three parts of galls to one is the best proportion, producing an ink sufficiently black, and proving the most durable; the durability depending upon the power of the galls which are the most

corruptible substance in the composition. The combination of the iron with the acid being little subject to change.

## DCCXCVI.

The other ingredient, gum arabic, gives a certain degree of viscosity. Without it the ink is so thin that it immediately sinks, and spreads on the paper. The gum arabic gives it a proper degree of viscosity, which limits the stroke, and in proper quantity it proves a sort of varnish; it enables us to lay on a greater quantity of ink, so as to stain the paper of a deeper colour; and upon drying it proves a varnish to defend the black matter, just as oil in oil paintings defends the colours from the injuries of the air. Other viscid substances, as sugar have been added; but experience has shewn that the addition of these is no improvement. The ink is liable to attract humidity when the writing is put in a damp place. Resinous substances are improper, as the water cannot dissolve them. As soon as the ink becomes mouldy it will soon fade, the galls having begun to undergo that corruption; so it is of advantage that the vitriol be not completely saturated, the ink is paler, but it soon becomes black afterwards. To prevent ink becoming mouldy the addition of a small quantity of cloves is of use.

## DCCXCVII.

Having thus explained the circumstances upon which the durability of ink depends, it is proper to make some enquiries with regard to an ink which might be still more durable than this. One method is to prepare the paper or parchment, by steeping it for some time in a

strong infusion of astringent matter, and this will communicate a slight yellowish tinge, (but this is by no means disagreeable) and the writing being supported by the gallic acid the paper contains, will prove more durable; but none of these methods of making ink can be expected to prove so durable as that used by the ancients, of which we have example in the Rites of the Harleian MSS. the parts of which are so totally decayed, that it is impossible to open them out in pieces larger than the scales of fishes, and these little bits still shew the writing perfectly fresh, but they used charcoal for their colouring matter, which is the least corruptible of any substance whatever, notwithstanding the power of the corrosive agents that bring on corruption letters on any body whatever, they still remain, which is an instance of a substance, and mixed with gum Arabic, it can be made use of as ink, but it is not entirely so the same, and is more easily erased. This ink we use penetrates into the body of paper, and is not easily effaced, but to have an ink of this durability, it is only to add to commercial a quantity of the dust of charcoal, which will have all the properties of the ink of the ancients, with those too of the moderns.

## DCC CVIII

With respect to the inflammable substances, sulphur unites readily with iron in the way of fusion, it penetrates iron more quickly, and unites with it more strongly than with the other metals, and this metal can be employed to separate sulphur from the other metals, by applying heat; i. e. if it is in its metallic state, but when we apply a roasting or burning heat, with the action of the air, the sulphur and the iron are consumed, more so than with

respect to most other compositions, and the sulphur evaporates, imperfectly burnt in the form of the volatile and sulphureous acid, a calx of the iron only remaining.

## DCCXCIX.

There is another way of applying sulphur to iron; if we take the iron in filings, and add the sulphur in powder, and with the assistance of water form them into a paste, or keep them some hours closely compacted in the vessel, the sulphur begins to be decomposed, the mass swells, becomes more bulky, and gets a drier appearance, and crumbles down in a sort of powder of a grey colour, and, applying water, we have sulphate of iron, a green vitriol in solution, or a compound of iron and the sulphuric acid.

## DCCC.

This effect of iron and sulphur enables us to understand the operation by which the common vitriol is manufactured. It is prepared by a process affording it much cheaper. The materials are a natural compound of iron and sulphur, a species of the pyrites. What answers the purpose is generally found in the neighbourhood of coal pits, in stony masses, generally lying in the same bed parallel to the coal, and forming a thin interrupted stratum. This has pretty much the ordinary appearance of the pyrites, it has a granulated kind of texture, and has frequently a mass of coal adhering. When exposed to the air, it undergoes the same change which an artificial mixture of sulphur and iron does; it gradually melts, the surface is covered with a whitish downy efflorescence, and when examined more narrowly, consists of oblong crystals of saline matter. By length of time the whole of

the mass is resolved, and upon applying water, all but the chalky matter is dissolved : the liquor it affords is found to be a solution of iron in the sulphuric acid, but containing an over proportion of acid ; it is of a yellowish colour, or reddish, and has some degree of viscosity, or an oily or unctuous appearance when evaporated suddenly, it being considerably diluted and requiring evaporation. It does not afford crystals, but an unctuous matter, which attracts humidity. To obtain good crystals we must infuse into it pieces of old iron ; the liquor is warmed to make it act more readily in a large leaden reservoir, which though corroded by the acid, is not dissolved. The surface of the lead is soon covered with a thin crust of oxyd of lead, saturated with sulphuric acid, and not being soluble, it preserves the rest of the metal from the action of the acid ; the liquor is kept warm, and towards the sides they place pieces of old iron till it is sufficiently saturated with metal. It is then run off and cooled, when it crystallizes on the surface, and on sticks put in for the purpose.

## DCCCI.

The manner in which the liquor is obtained in the common process, is by exposing it in beds in a field adjoining to the house. These beds consist of clay soil, and their bottom is laid with the toughest clay they can get : the pyrites is taken out of the coal-pits and spread on these beds, and by the influence of the air it is decomposed. It is conveyed by a gutter into a cistern in the floor of the house, out of which it is pumped into a leaden cistern, in which it is saturated with iron.

## DCCCH.

There seems to be something in the nature of the composition of the pyrites which is fit for this process. This knowledge of the nature of the pyrites, and of its decomposition, has been the foundation of some theories and opinions, with respect to some of the most striking phenomena in nature, as earthquakes, volcanoes, hot springs, &c.

That many of these phenomena derive their origin from mixtures of iron and sulphur, from large collections of the pyrites, which exposed to the action of the air and humidity, suffers this resolution, and in consequence of their great quantity, that great heat and exhalation of a great quantity of inflammable vapours, these phenomena are produced. What has further supported this idea is, that something resembling these can be produced artificially, if a considerable quantity, as 30lb. is mixed into paste, and buried at a moderate depth, in some hours an elastic vapour is produced, which begins to raise the ground a little, and from the irregular manner in which it rises, it gives us a shaking and trembling motion, and afterwards breaks out and takes fire, resembling the phenomena where there are subterraneous fires.

## DCCCHII.

From the experiments made to examine the nature of iron in mixture with other metals, it appears disposed to unite with them all, except lead, and there are none which dissolve it more readily than gold. When gold in fusion is mixed with an iron rod which is pure, and not containing sulphur, it is dissolved, and they unite readily. It is difficult to make it combine with mercury, though

in certain circumstances they can be made to act upon one another, the iron loses its toughness. Thus springs exposed to the contact of mercury become perfectly brittle.

It is difficult to unite iron with antimony, on account of the volatility of the latter.

It has a strong attraction for antimony and arsenic, and deserts many other substances to unite with them.

Iron, though mixed with any other metal, is still attracted by the load stone, except when mixed with antimony, which changes its nature in that respect, so as to render it incapable of being attracted.

#### DCCCIV.

Steel is nothing else but iron combined with carbon. It is done by a sort of cementation; the iron is prepared by being made into bars of a moderate thickness, that the cementing matter may penetrate them. The materials which are applied, are charcoal dust, or that mixed with a small quantity of soot, and with some common salt; sometimes with some vegetable ashes. These are put into vessels in the usual manner, as in cementation; first, they put in a quantity of the mixture in powder, over this some of the iron, then more of the mixture, and so on alternately, till the vessel is full, and the mouth of it accurately closed: thus, if the steel is made in a crucible, we can shut it up by inverting another crucible, and closing the joint perfectly, which is the most complete manner of shutting a crucible; the whole is kept heated to a pretty bright red, and when taken out the iron is found converted into steel.

#### DCCCIV.

The changes it has undergone are these; it is said to receive a small increase of weight; it is also more fusible.



it can be brought into a perfect fusion, which iron in its ordinary tough state is hardly capable of. It is more difficult to form under the hammer; it must be heated to a moderate degree only, and managed more gradually; for with violent strokes, or when strongly heated, it is liable to fly in pieces: thus the forging of steel is more difficult than the forging of iron: it is somewhat less ductile; when a piece is broken across, the internal texture is different from that of iron; a bar of iron has a rough surface, or rather with fibres or pointed particles which are prominent; a surface of steel has a number of shining plates, so that it appears altogether of a granulated texture.

#### DCCCVI.

But its principal change when converted from iron into steel, is its very great hardness, the very strong cohesion of its parts, and the great degree to which this can be increased by the temper; in this respect, the softest steel is far superior to iron; and, in consequence of the great hardness it can be made to assume, and the different degrees of it, all kinds of tools are made of steel, which not only cut iron with ease, but steel itself in its softest state. To temper it they heat it to a pretty strong red, and they know the proper degree by the look, and in that state it is cooled as quickly as possible, by plunging it into cold water; it is then extremely hard, it will mark glass like flint, and a file does not produce the smallest effect upon it. This is attended with a great degree of brittleness, the extreme hardness being attended with the total absence of flexibility; but the workmen can diminish this hardness, and communicate flexibility to any degree which they please, and by a very simple and easily managed process, they need only to heat it again; and if this

is done to the same degree as before it was changed, it is perfectly soft again: if they want to soften it only to a moderate degree, they must heat it less than this, and stop the heating of it as soon as it is brought to the due degree, by plunging it into water again, and the different abatements on different occasions can be judged of by the colour appearing on the surface, produced by a thin film of oxydated matter. 1st, An orange yellow, or golden colour, then a purplish colour comes on, then this is succeeded by a blue, which ends in a violet: if they heat it till it acquires only the orange colour, and then suddenly cool it again, it will have acquired a small degree of toughness, with a great degree of hardness, the greatest degree which is requisite for any tools.

## DCCCVII.

The steel instruments used in coining are tempered to this degree; other instruments are hardened nearly to the same degree at their points; others used for cutting iron are softened more; others made for cutting wood are made to assume the blue colour, which is attended with such flexibility as to prevent the edges, or points, from being easily broken.

## DCCCVIII.

With respect to the qualities of steel, they are the same in all kinds of mixtures, only it is not so easily dissolved, and it does not rust altogether so soon. It is more fusible too, and one of the greatest improvements made of steel is the fusion of it, by which all the parts of it are blended together and made more uniform; and any heterogeneous substances are thrown to the top, in the form of

scoriae. The best steel (so much valued) is made in this way, by melting pieces of steel together.

## DCCCIX.

With regard to the ores of iron, and the manner in which it is extracted, no metal is found more plentifully, but it hardly occurs in its metallic form, or free from admixture: in general, it is found in the state of a calx or oxyd; and it is very often intermixed with a certain proportion of sulphur.

The minerals wrought for iron are three, called iron ore, iron stone, and bog ore.

## DCCCX.

The iron ore is found in veins as the ores of other metals are, and the appearance is very various. Sometimes it has a rusty colour, resembling that of iron, sometimes it has a reddish cast; often it is formed into a kind of chrytallizations, which are protuberant knobs on the outside, and these consisting of fibres tending to a common centre, and often it is of a dark colour, like coagulated blood, and is called hematites or blood stone; it consists of an oxyd of iron with a small quantity of sulphuric acid.

Iron stone in Scotland is clay, found in strata with coal, but when contains a large quantity of iron, so as to render the working of it profitable. Sometimes it has little appearance of iron; but when burnt with a certain degree of heat, it becomes of a deep red.

## DCCCXI.

The bog ore is an ochre, or oxyd, of iron, and is generally found in low situations, and in springs containing a small quantity of iron, which, flowing over the grounds, deposit it in the form of ochre; and, after a number of ages, it

proves a rich mine of iron, and is extracted from an oxyd of this kind in many parts of the world.

Besides, it is found chrystallized in a number of different forms, preserved in the cabinets of the curious. And the ores of most other metals contain more or less iron, as do also all the coloured elays and boles, the earths and precious stones, as the granite, &c.

## DCCCXII.

The ashes of vegetables contain iron, and the different parts of animals, as the blood, milk, flesh, have been found to contain a small quantity. When these substances are kept red hot with inflammable matter, upon applying the magnet a number of particles fly to it. So there has been a dispute, whether the iron was pre-existent in these substances, or was produced during the destruction of these substances by heat; but it abounds every where, and we can easily imagine how it should pass into the composition of vegetables, and from these into animals.

## DCCCXIII.

But fossils of iron are useful on other accounts, as the aktiv red and yellow ochres, which are used as pigment, some of them are of a fine red and yellow colour, and are very durable.

Red chalk is a kind of clay containing a large proportion of iron. There is a particular kind of spar found in many parts of the world, of a pale blue colour, so that from its first appearance we should expect copper in it, but it contains a small quantity of iron, as in the Prussian blue.

Similar to this, in the hard stone called emery, which

affords the powder employed for grinding other stones, is contained iron combined with the stony earth.

## DCCCXIV.

The leadstone is a noted ore of iron ; it is always found in veins ; and it is alledged that it is only possessed of its magnetic qualities when near to the surface. In appearance it does not differ from many of the ores of iron, and heated as an ore, it affords a considerable quantity of it.

Though the ores of iron are thus plentiful, yet only the richest of them are wrought ; if they contain too much sulphur they cannot be wrought with advantage, the sulphur adhering strongly, and giving a bad quality to the iron ; and if there is much earth, the ore turns out so infusible that it requires much fuel, and the yield of metal is too small to compensate the expence.

## DCCCXV.

It is usual to roast the ores of iron containing sulphur, or sulphuric acid, which are thus expelled, then they are melted in a large furnace, which is now made of a much larger size than formerly, and a quantity of lime is added, in order to bring the ore into fusion, and some have supposed that it attracts a part of the sulphur, especially the common ore melted in this country, called iron stone, having much clay and sandy matter, it requires the addition of lime. Some time ago it was thought necessary to use the charcoal of wood, and for pure bar iron and tough iron it is necessary ; but for casting, the iron can be obtained by means of pit coal charred, which is much cheaper ; as first run down from the ore, it has not all the qualities of iron, but the external appearance and internal qualities are different ; it is of a light blue, and when

broken, it is of a dull white, approaching to polished silver; the fracture is smooth, and of a cross and uniform texture: it is not a solid mass, but consists of a number of crystallizations, which are branched and figured, and which leave small interstices, making it impossible to give it a fine polish. The microscope shews that it consists of plates like those of the brittle metals, though not so obvious. It is, likewise, very hard, yields little to the file or chissel, and has not the least malleability, or flexibility; it readily breaks upon being bent, and it is liable to melt by sudden heating or cooling, and it is not so liable to rust and dissolve as iron brought to its most flexible state.

DCCCXVI.

Some kinds of cast iron are softer to the file, and have a degree of toughness, but these are not the purest; they do not contain the greatest quantity of pure iron in the refining furnace. The iron in this state, is called pig iron; it is cast into oblong bars, called pigs. It acquires the malleability and toughness of iron, by the operation called forging. A considerable quantity of it is heated on a hollow forge covered with charcoal of wood; the heat is raised till the iron is gradually melted, and it is kept in this heat, and the bellows blown upon it, so as the wind is directed on the surface of the metal; in this way a quantity of it is converted into droffy scorixæ, which are let out by a hole in the side of the forge, and by the continuance of the operation the iron forms an irregular cavernous and spongy mass, which is subject-d to the action of a large and heavy hammer wrought by a wheel, which compacts it into a thick square lump, the parts of which are imperfectly united, but upon heating it again it be-

comes soft, tough, and malleable, so as to be drawn out, by the action of the hammer, into bars. In this state it is composed of fibres. When we put it into any weak solvent which will act more readily on the soluble parts, it appears manifestly to be divided into fibres.

## DCCCXVII.

With regard to the nature of the change it has undergone, it loses a quantity of dross, mostly of an earthy nature, and it may lose half its weight in this way, and likewise its carbon and oxygen uniting are expelled. Thus iron before this possesses a quantity of earth and oxygen, and where the former predominates, it bears some resemblance to steel: they are both hard and inflexible they have the same texture, and agree a little in colour, being both whiter than tough iron, and they are both less liable to rust. If steel be cemented by the same materials, it comes to be overcharged, so as to be like cast iron, it is incapable of being forged, unless it is exposed to the action of heat and air, to dissipate a part of its carbon and oxygen, it cannot otherways be welded; and the purest kind of cast iron, melted and forged to a certain degree, becomes steel; and we are likewise told, that steel is made in this way in some places of Germany, though it is not of so equal a texture.

## DCCCXVIII.

There is a further experiment which throws light upon the subject. It is a process described by Pliny, and followed by the ancients, to convert iron into steel. They plunged it into melted cast iron, and kept it there some time, when it was changed into steel; so cast iron contains something which converted it into steel. It contains

carbon or the principle of steel. So Reaumeur tried if the same cementation had the same effect on cast iron, and he found his experiments to succeed. When iron is cemented with bone ashes, from the phosphoric acid it returns to the state of soft iron, and is called cold short iron; cast iron heated in the same manner likewise acquires the same qualities. This is an art worthy of cultivation, that the iron in its brittle state may be cast into any mould, and then by cementation be converted into tough iron, whereby the fine and delicate parts would not be so liable to be taken off by the smallest accident; and this might be brought into practice as an art. Thus a proper cement will convert the external parts into tough iron, while the internal parts retain their fusibility; so that in this way, a cannon-ball might be reduced to the form of a shell: this is an improvement in some of the works made of this metal, that a great part of the metal may run out, so as to make them lighter and save a part of the metal. We next proceed to consider copper.

## DCCCXIX.

*Copper.*

The obvious qualities of this metal are well known; it is more ductile and malleable than any of the metallic substances yet described, so it is a more perfect metal. It is next to iron in hardness and strength, not being so easily inflammable, and not striking fire with hard bodies. It is used in place of iron for their hammers, &c. in gun-fire works. It has a palish green colour, in consequence of fusion. It is observed, that this metal does not bear to be melted, and it is difficultly cast solid; unless it is heated stronger, it forms a metal which has not a proper degree of toughness; and if it is over-heated, a number of air holes is



produced; so, in casting cannon, it is necessary to add other metals, as zinc, or brass, to increase its fusibility. Another particular in the melting is, the great danger attending the approach of watery humidity, the violent explosion thereby occasioned, often totally demolishing the works in which the metal is cast. This is particularly owing to the great heat it acquires in its fusion, and partly to the great quantity of heat it contains when heated to a great degree, in which it exceeds every other body. There are some operations which require the copper to be reduced to small grains, or particles, which is done by pouring a quantity of water upon it in its melted state, but they are obliged to take every precaution to prevent the consequence of these explosions. A cavity is sunk in the ground, over which is placed a cover, which is very strong, with thick bars, or plates, of cast iron, and the copper is made to run into the water with a very small stream: it produces violent explosions which shake the ground, and even sometimes bursts the apparatus in pieces.

## DCCCXX.

When we calcine the metal, it is best done in a heat inferior to its fusion. It is soon covered over with a dusty crust, which flies off its surface when bent. This kind of calcined matter is produced in consequence of its absorption of oxygen, and it easily returns to malleable copper again.

It strongly resists the injuries of the air and humidity. It acquires an obscurely glossy skin, or oxyd, which defends it like a varnish.

The saline substances act upon it with great facility, the more simple ones dissolve it, and the more weak corrode it.

The sulphuric acid requires the assistance of heat, and to be applied strong, which oxygenates and dissolves it, forming a solution of a pleasant blue colour, and this being evaporated, very easily affords chrystals of a pleasant and transparent blue colour when fresh, and are known under the name of blue vitriol, or sulphate of copper. The manner of manufacturing this is not by uniting pure vitriolic acid to copper, except in particular cases, when it is done with a different view, as in some places where large quantities are manufactured in thin plates, which are gilded; these are dissolved again into sulphuric acid, in order to separate the gold. But the common manner of obtaining it is from the copper of pyrites.

DCCCXXI.

The action of the nitric acid is in no way particular; it dissolves it as usual, which is experienced by the disengagement of much nitrous gas, and the solution turns out of much the same colour as that by the sulphuric acid, a very fine blue and green colour being produced, according to the strength of the acid. By evaporation it may be reduced to the form of chrystals, being nitrate of copper, but they are strongly deliquescent. The action of this salt is peculiar upon tin.

DCCCXXII.

The muriatic acid acts only upon it, boiling and concentrated; it produces a green colour, of a different tinge, sometimes a pleasant grass colour, sometimes a darker colour, like that of fading vegetables, according to the concentration of the acid, or the muriatic acid may be united to copper by the medium of muriated mercury, forming a dry substance which melts with a gentle heat, like the

plumbum corneum, and melts like rosin. The compound is volatile, and tinges the flame of a candle green. This is observed in many of the preparations of copper; for even the copper reduced to fine filings, and thrown into the flaming fire, tinges the flame of a blue or green colour.

## DCCCXXIII.

When copper is dissolved by the acetic acid, it gives a green of a different tinge; the solution being evaporated, affords chrystals of a dark green colour, which give a powder of a bright and pleasant green. These are known to the painters, under the name of distilled verdigrease, or cupricum acetatum, but improperly; the reason is, that they are produced by distilled vinegar, in which copper is dissolved. To do this, we must not only apply it in its metallic state, but we must take it in the form of a rust, or oxyd, produced by means of the vegetable acid itself. This is known by the name of verdigrease; it is of a pale bluish green colour, it is prepared in large quantity from the husks of the grape; after the juice is squeezed out there remains a fermentable matter, capable of acquiring acidity; this is put into earthen pots in alternate layers with plates of copper; and these are arranged in rows on a dunghil with horse dung, by which the fermentation is raised, and an acetic acid produced, which rusts or oxydates the copper; and the plates being bent, the rust or oxyd is struck off, brings verdigrease. This is dissolved easily in distilled vinegar, tinging it of a greenish colour, like that produced by the muriatic acid; and from that solution the chrystals, called distilled verdigrease, are obtained.

## DCCCXXIV.

These combinations of copper with acids can all be decomposed; that with the sulphuric acid can be decomposed by means of heat, though with difficulty, it requiring a violent heat. The compound with the nitric acid is more easily decomposed; that with the muriatic acid more difficultly, as it adheres to the copper and volatilizes a part. The most easily decomposed is that with the vegetable acid, which retains it so slightly, that heat alone will totally expel it; and in this way we have an opportunity of reducing the vegetable acid to its greatest degree of strength, we can bring it into a dry form, we can evaporate the whole of the water by applying heat, and raising the acid in vapour, the copper remains behind, not retaining it so strongly as to occasion its being exposed to a red heat, as when it is combined with a fixed alkali in the sal djureticus, &c. which retains the acid till the heat totally destroys it, but with the copper the acid is separated sooner, and we have it in the greatest degree of strength, and it is called concentrated spirit of verdigrease.

## DCCCXXV.

Besides the effects of heat in decomposing these combinations of copper with acids, we can take the assistance of additions; we can add substances having a stronger attraction for the acid, as the alkalies and absorbent earths. All of these occasion a precipitation of the copper; the absorbent earths precipitate it in the form of a powder of a light and pleasant blue, a portion of it being deposited in the earthy particles. It is used by the painters under the name of verditure.

## DCCCXXVI.

The alkalis precipitate it like verdigris, but the quantity of the alkali being increased the copper is re-dissolved, and produces a rich and beautiful blue. The most remarkable precipitation and re-dissolution is by the ammoniac. The blue produced is so extremely rich, that a very minute quantity of copper becomes visible in a large quantity of water. It is said that  $\frac{1}{10}$  part of a grain of copper will be easily detected in a pint of water.

## DCCCXXVII.

The colour produced by the combination of the ammonia with the metal can be again destroyed, and re-produced; and by adding an acid and alkali alternately, the colour appears and disappears as often as we please. So the deep coloured rich blue solution is a compound of the ammonia with copper, and it is only when the ammonia prevails that the deep blue solution is produced.

## DCCCXXVIII.

There is a preparation in the shops called aqua sappharina, which is made by putting into a brass mortar some lime water with a little muriat of ammonia about 24 hours, the lime water decomposes the muriat of ammonia, and the ammonia acting on the copper, the solution acquires a light blue colour.

## DCCCXXIX.

There is at present made use of in medicine a compound of copper with ammonia in this way, which is thought to have virtue in the cure of the epilepsy. It is prepared

from blue vitriol the process recommended is, to prepare it, from this dissolved in water and filtrated; to this is added a quantity of ammonia, sufficient for precipitating the copper and afterwards redissolving it. When the ammonia is added to the filtrated solution, it effervesces, and precipitates the copper so copiously, that the mixture becomes quite thick at first; but repeating the addition of volatile alkali, we gradually saturate the whole, and redissolve the copper; in doing which we must take care to agitate the liquor, and to observe if any oxyd in the form of white particles remains undissolved. There is no danger in adding too much, the following part of the process will dissipate this: what remains to be done when the copper is completely dissolved is, to pour the liquor into a china plate, and set it before the fire, or in a sand heat, not much above that of the human body. It soon evaporates, so as to leave a crust of saline matter, containing the two compounds of ammonia, with sulphuric acid, and the alkali with the oxyd of copper. It is this latter compound which is efficacious, the other neither does good nor harm; but as the efficacy of the preparation depends on the combination of the copper with the ammonia, the most gentle degree of heat must be used, otherwise the ammonia is separated from the oxyd of the copper, and it is proper to scrape it together, to grind it to a powder, and close it up in a vial, when it forms a powder of a deep blue colour.

It is likewise obtained in a solid form by mixing 3 parts of carbonate of ammonia with 2 of sulphate of copper. This forms a compound, known by the name of the ammoniated sulphate of copper.

## DCCCXXX.

When the calces of copper are mixed with earthy substances, they give them a tinge like those of their solutions with acids, giving blues of different shades.

Sulphur unites strongly with copper, forming a lead-coloured mass, not easily decomposed again. Though iron has a stronger attraction for sulphur, the copper has the property of retaining it more strongly; so that when these two metals are exposed to heat, the iron is much more disposed to be oxydated, and consequently to lose its attraction for the sulphur, in the sulphur does not unite with the oxyds of metal.

## DCCCXXXI.

Some other inflammable substances act upon copper, as the aromatic and rancid oils, and oil of turpentine and tallow, when rancid from the presence of the sebacic acid, they dissolve a small portion of it so as to be tinged blue or green; and, in short, this metal is so liable to the action of solvents, that it is remarkable in this way.

## DCCCXXXII.

The most useful compounds of this metal are the combinations of it with zinc, which compose

Brass, bearing a greater or less resemblance to gold. The manner of making it shall be taken notice of: with a certain proportion of arsenic it receives a white colour, and forms a compound metal, called tutenag, which is manufactured in this way with arsenic and brass; with a small proportion of tin it is hard and elastic, and constitutes bell metal, the mirrors of telescopes, and burning concave mirrors; it is also added to the more precious metals, gold and silver, and it is the only metal which can be mixed

with them, without destroying their ductility ; a small quantity of it gives them more firmness and hardness for the formation of different vessels.

DCCCXXXIII.

The relation of lead to copper is particular ; it does not unite with the copper unless it is very hot ; unless it is brought to its boiling heat, when it scorifies, then the copper unites with it with rapidity, but allowed to cool, by the time the lead congeals the copper separates, and again chrySTALLIZES into a number of fibres, while the lead cools into a number of little particles throughout the mass, but does not intimately combine with it, we see the lead and copper separate from one another. In consequence of this, lead is readily separated from copper, if the mass is heated in such a situation that any melted matter may flow from it, as by placing it on an inclined plane in a certain degree of heat, the lead sweats out of the pores of the copper, the copper remaining in a spongy mass ; so it is used to separate sulphur from copper, which it does most effectually. It is separated from the other metals by many different processes, according to the nature of the metal.

DCCCXXXIV.

The ores of this metal are met with in all parts of the world ; but the most remarkable are found in Sweden, Hungary, and Transylvania. Such an ore may be known by a green or bluish colour about it. Specks are perceivable in the surrounding stones, or on the surface there is a green powder like verdigrease dissipated from it. If there is any doubt, it is easily known, by putting a small quantity into a vessel, and dropping into it some drops of



ammonia, immediately it is dissolved, and produces the deep and rich blue colour. There are some blue ochres which derive their origin from iron, which are not thus dissolved. The copper sometimes occurs in the veins in its metallic state; and it is the first of the metals which is thus found by nature. Tin, antimony, and even iron, occur in their metallic state, but exceedingly rare; but copper is thus found frequently intermixed with the stony matters of the vein, and such stones are of a reddish colour from the small particles of copper, the copper uniting into exceedingly fine filaments, much finer than hairs. A particular kind of copper is found in moors and bogs, formed by the deposition of that metal, or vegetable inflammable substances, which these bogs contain, and this is also in its metallic state, but it is much more frequently found in the state of an ore combined with sulphur, and generally with some arsenic, and it is seldom free from both these substances, and also from a portion of iron.

## DCCCXXXV.

The ores may be arranged into three divisions. 1st. A pretty pure oxyd of the metal united with a small quantity of sulphur, arsenic, or iron. This appears in different shades of green or blue, sometimes of a very deep blue, and forming a sort of chrysal, which is called the *minera cupri vitrea*; they give the name of vitrea to the richest ores of metals: sometimes it is of a green colour, like verdigrise, called *minera viridis*. It is generally mineralised (to use the common term) by combination with sulphur or arsenic, which melts with it in this state in different degrees of purity; when there is but little iron it constitutes a grey copper ore of a dark colour, duller than that of lead; sometimes it is purplish when it is fresh

broken interspered with spar and a flinty matter, called the *minera cupri lazuria*.

## DCCCXXXVI.

Another kind of it, which is more common, (and from its plenty is highly valued,) is the copper pyrites; it contains more iron than copper, but the copper is valuable, and so it is wrought on account of the copper. Here it is combined chiefly with sulphur, and a large proportion of iron. This kind of pyrites is easily distinguishable from what is commonly called the iron or sulphur pyrites, which contains nothing else than sulphur and iron. The iron pyrites are very hard, so as to strike fire with steel, but the copper pyrites are never so hard as this, the point of a knife makes no impression upon them; besides the colour is different, the copper pyrites is more yellow, approaching to that of gold, and the fractures of it have the different shades of the rainbow colours upon them. In some parts of England there are great quantities occurring, chrySTALLIZED on the surface of spars, which make a shining appearance; the metallic matter is attended with a tinge of the rainbow colours.

## DCCCXXXVII.

With regard to the extraction of copper from these ores. When it is in its metallic state it needs only be refined, the sulphur or iron requires to be separated by melting it in a hollow forge, in which the heat is raised by fuel on the surface of the metal, the air thus promoting the scorification of the more destructible parts; so the iron and arsenic, as being more destructible and volatile, are scorified and taken off to aside, till the copper is at least sufficiently refined. This operation is practised more successfully, if a quantity of lead be added, which promotes

the scarification of these more oxydable substances, and leaves the copper pure and fine. It is true, that when lead is employed, a part of the copper is scorified, lead having great power in promoting the oxydation of other metals ; but it has little of this effect upon copper. In Sweden, where large quantities are manufactured, they have a particular manner in taking it out of the furnace. The furnace is conical, contracting in the bottom, and is lined with a lute of charcoal dust and clay, when the copper is refined, which they know by dipping into it the point of an iron rod, to which the copper adheres, they then clear away the fuel and scorified matter, and begin to take out the metal ; but as the quantity is very great, it would require a long time to cool of itself, (and it would be impossible to take it out of the furnace,) so they pour a small stream of water upon the surface, which flows round the metal without touching it, as mercury upon wood ; for the water being warmed before, the great heat of the metal converts it into vapour, so that there is always a vapour interposed, which prevents them from coming into contact, but the water evaporates first, and occasions a consumption of the heat of the copper, and a crust of it is hardened, which is raised up by means of an iron lever, and removed, a fresh surface being congealed in the same manner immediately after, and this is repeated till the whole mass is taken out. These crusts are laid on the floor one over another ; they become gradually narrower, forming a pyramid, or cone ; when taken out in this manner, it is called rose copper, having a bright and rainbow colour on the inside, and a roughness (making it bear a resemblance to a rose expanded,) and the copper in that state is reckoned extremely fine.

## DCCCXXXVIII.

If the copper is found in the state of an oxyd, the operation is very simple. It is reduced to its metallic form, and the copper obtained by refinement: but where it is combined with sulphur and arsenic it costs trouble and repeated operations, (these substances adhering strongly, as does also a quantity of iron, which seldom fails to be present.) These ores are treated by repeated roastings and fusion; every time a quantity of the sulphur and arsenic evaporates, and the iron is scorified. The iron, without the presence of these, would be difficultly separated, but the sulphur and arsenic favour the oxydation of the iron, so that it can be converted into scoriæ, while the copper is not so subject to this scorification; so these volatile substances are gradually dissipated, and at last the copper turns out pure, but it is never so pure as when a quantity of salt is mixed, or added to it, in order to promote its refinement. There are some of the ores which are so very impure, that it is hardly possible to extract it even by water in the way of solution.

## DCCCXXXIX.

*Manganese.*

Manganese is a metal of a grey white colour, soon decomposed by exposure to the air, by which its surface becomes oxydated. It is very generally diffused both in the earth in various forms, as also in the ashes of different vegetable products.

The native oxyd is its most abundant ore, and from its different degrees of oxydation, it varies in colour, texture, and form: but it has commonly an earthy texture, and generally a brownish or bluish black colour.

This oxyd is difficultly reduced to the metallic state,

and it can hardly be obtained but in small fl. bules, which, on exposure to the air, lose their colour, and fall at last into a black powder. This is the consequence of oxydation, and it is very quickly effected on them with the assistance of heat, though at a low temperature.

Two principal species of oxyd of manganese are found, the white and the black. The former is the oxyd in acids precipitated by alkalies, the latter the same oxyd exposed farther to the action of heat, and intermediate gradations are occasionally produced.

The former of these possesses the strongest attraction to oxygen of any metal whatever, but the increased quantity in the latter is separated by the temperature of ignition.

These two oxyds also clearly prove that solubility in acids only takes place in a certain degree of oxydation. Thus the white oxyd is soluble in all acids, while the black remains undissolved in the sulphuric and nitric acids, unless an inflammable matter is added to remove part of its oxygen, but it dissolves in the nitrous and sulphureous, a confirmation of the same fact, but it combines readily with the muriatic acid, and oxygenated muriatic acid is formed.

#### DCCCL.

The sulphat of manganese is soluble in water, and crystallizable. The nitrat and muriat remain always soft and deliquescent; they are decomposed by the alkalies, and a white precipitation ensues. The fixed alkalies combine with the black oxyd. This combination is formed by exposing it to a strong heat in a proportion of one part to two of the salt. The compound dissolved in water varies in colour, and turns from green to purple, and then to

red, and the addition of nitric acid renders it colourless, so it is termed the mineral chameleon, or alkaline oxyd.

Manganese is incapable of combining properly with sulphur, though eight parts of oxyd with three of sulphur form a mass of a greenish yellow colour. It combines with phosphorus, forming a white metallic compound. It possesses likewise an attraction to carbon. Its combinations with the other metals are at present little known. Its strongest attraction seems to iron.

The oxyd unites by fusion with the earths, and thus, from its use in glass-making, termed glass-makers' soap. In a large quantity it gives a violet colour to glass: in small quantities, it used to glass discoloured, by coally particles on iron it renders it colourless. It gives the black glazing to pottery ware.

## DCCCXLI.

*Argentum.*

This metal in extracting it from its ores is commonly procured in the state of a white oxyd. It is distinguished from every other metal by its solubility, and when heated with the access of atmospheric air it is easily oxydated. In the temperature of ignition it burns with a blue flame, and emits an albaecous smell. This oxyd has a sharp caustic taste, is soluble in water, and in boiling water its solution, on cooling, affords crystals; by farther oxydation it is completely acidified.

The white arsenic of commerce, or imperfect oxyd, is hardly dissolved by sulphuric acid. Nitric acid by its communication of oxygen acidifies it; the nitrate is, therefore, hardly to be obtained. The muriatic acid dissolves

it with facility, and two varieties of combinations with this acid are formed, differing in their degrees of oxydation.

Oxygenated muriate of arsenic is concrete of a soft consistence, and is decomposed by water.

Oxyd of arsenic combines with the fixed alkalies, and also their solutions in an increased temperature: this saturation is thick, tenacious, and emits fumes of arseniated hydrogen. Ammonia and lime water also dissolve a part of the oxyd.

Acid of arsenic is attained by the distillation of white oxyd in nitric acid, the residue remaining on the discharge of the nitrous gas, is the acid in a concrete form. It is soluble, in twice its weight of water diliquesces, and shews the test of an acid by reddening turnsole, and has a caustic taste. The acid combines with the alkalies, and forms, by solution and evaporation, some salts which are little known.

#### DCCCXLII.

With regard to the earthy substances, their vitrification is hastened by it; and it is found an useful compound, or addition to glass, the greatest consumption of it being in this way. It is a common practice to plunge a piece of it tied to the end of an iron rod, to the bottom of the pot, which quickens its refinement and clarification, the alkali which the glass contains fixes the arsenic, which diffusing itself through the glass, increases the tenuity of its fusion, but the glass then made soon tarnishes.

With the inflammable substances it unites with sulphur into a compound, or sulphuret, that is more fusible than the arsenic, and that in proportion to the quantity of sulphur. Some of the compounds can be melted easily into a perfect fluid, and the colour varies according to the propor-

tion of sulphur. When a small quantity of sulphur is combined the colour is yellow, and it forms orpiment; and when the proportion of sulphur is large, it is of a deep red colour, and forms a powder which is called red arsenic, or realgar.

The poisonous quality of the arsenic is very much abated in this compound, as is the case with other mineral substances that have a great power over the human body, as antimony and mercury; they may be separated by adding a small proportion of alkaline salt, and subliming the mixture.

Phosphorus combines with arsenic, and forms a compound of a black colour and metallic lustre, oxydated by the air.

### DCCCXLIII.

The relation of arsenic to the metals remains to be considered; it unites with the whole; it is applied in the way of cementation mixed with charcoal dust, or black flux; the metal is beat into plates and interspersed with this mixture in a crucible; its effect upon the metals is to give them a white colour and to render them brittle; no mixture of this kind has been found useful, except that of copper. It communicates some degree of a white colour to it, so that approaches to silver, and it is called French plate, but is attended with a yellowish cast; this, however, does not appear in candle-light.

With regard to the origin of arsenic, it is found pure in a grey powder, or contracted into a solid substance, but pure arsenic is a very rare mineral; though in the state of combination there is plenty of it. It abounds in a great many of the ores of lead, and in a compound of iron called



white pyrites, having a whiter colour than the pyrites of iron and sulphur; when these are struck, they give out an odour resembling that of garlic; but the ore containing it in the greatest quantity is the cobalt.

We meet with native compounds of arsenic with sulphur: they resemble the artificial compounds, only they are of a foliated texture, placed between the eye and the light they appear transparent like the artificial compound, and assume the same appearance when melted.

#### DCCCLIV.

The greatest part of the arsenic found in the shops, or made use of in arts, is obtained from the ore of cobalt, the oxyd of which tinges glass of a deep rich blue colour, so is employed for the decoration of china and other earthen ware. The arsenic in this ore is in its metallic state, and evaporates freely when red hot; the cobalt is heated in a large furnace in the form of an oven; at one end there is a place for a fire, and in the other a vent drawn off in the form of a gallery, through which the smoke and steams pass a long way before they are allowed to escape, and the condensable matter is allowed to condense, workmen are put in to collect it, and the matter is found to be arsenic, the metallic part of the matter remaining fixed on the floor of the furnace; but it contains a considerable quantity of sulphur from the pyrites and other sulphureous minerals.

To purify it from the sulphur it is treated in the way of sublimation, when it sublimes in its ordinary form.

Such is the history of this mineral, which best deserves the name of a poison of any substance we have expe-

rience of, as, in the smallest dose, it has been found to produce hurtful effects.

## DCCCXLV.

The study of the physician is more directed to the means of remedying the bad effects produced by it occasionally, and to the detection of crimes that are committed by means of it, than to any other points. The means of preventing the bad effects consist in the sudden evacuation of the arsenic, by a vomit given immediately, and after that a purge, and we mitigate the mischief it occasions by giving a great quantity of diluent and bland substances, as milk, oil, and the like.

With respect to the means of detecting and discovering it, our attention is commonly directed to some substance suspected of being arsenic, some remains of which are presented to us, or to the examination of the dead body. In examining a supposed arsenical substance, it is easy to do it certainly; we need only put a little of it on a red-hot iron; if it evaporates with red fumes, or, when mixed with two parts of charcoal dust, if it evaporates in the same manner and diffuse a penetrating smell of garlic, it is then arsenical.

## DCCCXLVI.

*Niobodaena*

Is a semi-metal, of a metallic lustre or appearance similar to plumbago. Its only ore is a native sulphuret, of a light gray colour, smooth and unctuous on its surface, and of a soft laminated texture, soiling the fingers. It is difficult to reduce it to a metallic state. Exposed in the

fire to a strong heat, sulphurous flames are disengaged from it, and an oxyd prevails.

This metal is capable of undergoing oxydation in four different degrees. The first degree forms a black oxyd, the next, a blue; the third, a green; and the fourth, a concrete acid of a yellowish white colour. In these different states it possesses but a weak attraction for oxygen; and it is, therefore, deoxydated by hydrogen, and by digesting it with any of the metals.

The molybdic acid melts and is decomposed by heat; is soluble in about 750 times its weight of water, and in the sulphuric or muriatic acids. By its combination with the alkalis and earths various molybdates are formed which have not been yet examined. The same may be said of its combinations with a number of the metals.

### DCCCXLVII.

#### *Tungsten.*

This has been obtained, in a metallic form, from the mineral named tungsten, or ponderous earth, and also from wolfram; so that both are ores of one metal.

### DCCCXLVIII.

The metallic oxyd is obtained by digesting the mineral in fine powder, in three parts of nitric acid, when a yellow powder is deposited; or from wolfram, by boiling the mineral with muriatic acid. In both cases a yellow powder is procured, which is again reduced to the metallic state, formed into a paste with oil and charcoal, by exposing it to an intense heat. The metal is of a greyish colour, hard and brittle.

DCCCXLIX.

The yellow powder is tasteless, and insoluble in water. It combines with the alkalies and several of the earths; but has less the character of an acid than of a metallic oxyd. Neither the oxyd nor the metal have been applied to any use; but the former has been prepared as a basis for pigments, since it forms permanent colours with many vegetable substances.

DCCCL.

*Titanium.*

This is a newly discovered metal. It exists, in oxyd, in a greyish black sand found in Cornwall, under the name of manachanite, and in the ore named titanit and red schorl. This oxyd is of a red colour; and by heating it with inflammable substances, it acquires a yellow or blue. It is very hard and infusible; it is soluble with heat in the diluted mineral acid, affording gelatinous solutions that yield crystals by spontaneous evaporation, and are decomposed by the alkalies. Prussic of potash gives a green precipitate, and the gallic acid a brownish red. It unites with none of the other metals but iron. It is also hardly reducible to a metallic state.

DCCCLI.

*Uranium.*

This metal exists in the mineral named pech blends, combined with sulphur and iron, in chalcocite united with carbonic acid, and in uranitic ochre mixed with oxyd of iron.

DCCCLII.

The oxyd of this metal is of a lemon yellow colour,

infusible by heat, but changed by ignition to a brownish grey. When mixed with carbonaceous matter, and urged by heat, metallic globules are formed which are of a steel grey, with little lustre. By heat it affords a yellow oxyd.

The nitric acid oxydates and dissolves it.

The other acids combine with it, and form neutral salts, which crystallize. Its oxyd combines with the alkalies, and by fusion it may be combined with the earths.

Both the metal and oxyd combine with sulphur.

### DCCCLIII.

#### *Tellurium*

Exists in several ores of gold. Its colour is white or greyish, with a considerable share of lustre. Its texture is laminated and brittle. It is one of the most fusible metals, and is easily volatilized. It becomes oxydated by much heat, and burns with a blue flame.

### DCCCLIV.

The oxyd of tellurium is white, turns yellow with heat, and it is not easily reduced by heating it with inflammables.

### DCCCLV.

Tellurium is oxydated and dissolved by the nitric and nitro muriatic acids, and the saturated solution of the latter is decomposed by water. The sulphuric acid likewise dissolves this metal, and communicates to it a fine red colour.

The alkalies throw down a white oxyd from its solutions. It is also precipitated by iron, zinc, tin, and antimony. It unites with several of the metals.

## DCCCLVI.

*Chrome.*

This metal is found in a species of lead ore, and it is named from its communicating brilliant colours to its combinations. The oxyd of this metal is the colouring matter of the emerald.

## DCCCLVII.

The acid of chrome is of a ruby colour, in prismatic crystals, soluble in water, with a sharp metallic taste. It combines with the alkalis, and salts are formed of a golden yellow colour, and it unites with the different metals, forming compounds, distinguished by their splendour of colour. Fused with phosphoric acid, or borat of soda, globules are obtained of an emerald green colour.

## DCCCLVIII.

Muriatic acid acts on it most powerfully. When heated with it, oxygenated muriatic acid is formed, and the solution assumes a deep green colour, from the oxydation of the metal.

The nitric acid oxydates it but sparingly.

## DCCCLIX.

We have now examined all the principal metals but those commonly known as the most noble and perfect, which possess in a more eminent degree these qualities by which the metals in general are distinguished from the other classes. They are more perfect and unchangeable, resisting not only the action of the air, but some of the most powerful agents.

## DCCCLX.

The qualities by which gold and silver are distinguished

from the other metals, are, 1st, Their amazing ductility and malleability in experiments made on silver, shew that a single grain can be drawn out into wire three yards in length, and this can be further beat out an inch broad. The extensibility of gold is still more astonishing, as we can learn from the art of gilding and of making gold lace, where the surface of silver wire is covered with a thin film of gold: thus four ounces of silver has its surface covered with one ounce, about half the bulk of one ounce of silver; it is then drawn out to such a degree that two yards of it weigh only one grain, which is made to pass through two steel cylinders; it squeezes into a flat part, and rolled on a silk thread, which is made to turn round with great velocity. All the whole is covered with it. During all this time the gold stretches out, so as to cover all the surface; and even when viewed with the microscope, it is all over covered with gold. Calculations shew that the thickness of such a film of gold is not above the four or five thousandth part of an inch. But the proportion of gold laid on silver, which is barely sufficient for covering its surface, is much less than this. It is necessary that the lace should bear some wear.

DCCCLXI.

Reaumur, who has made experiments upon this subject, found that it was possible to cover the whole surface of the silver with a film of gold; that it was not equal in thickness to a millionth part of a line, so that it would require 12 millions of them to make up an inch. We seldom have any extensive ideas of such numbers, the imagination by no means comprehends them; but to conceive this a little more clearly,

let us only consider what thickness 12 millions of the leaves of common writing paper would make; the thickness would amount to more than half a mile, so that the ductility and malleability of this metal is very amazing.

## DCCCLXII.

Another quality is that of enduring the action of heat and air, without being oxydated. The strongest heat, without air, does not produce the least effect. After exposing gold and silver in a glass-house furnace for a month, they were unchanged; the silver had lost a small part of its weight, which might be imputed to its impurity. Some time ago we were told that gold and silver had been vitrified by the heat of the focus of the largest French burning glass; but several of the French academicians assure us that it was a mistake. It has been volatilized; but the vapours, when stopped, condense into little globules of gold, in its metallic state; so these cases where it has appeared were deceptions, from the vitrifications of some part of the support on which it was laid. This is a circumstance too in which they differ greatly from all the other metals, none of which can support the action of heat and air without being calcined.

## DCCCLXIII.

Another circumstance in which they agree is, that they are not affected by nitre, which so quickly oxydates the other metals. When heated violently with nitre they are in part volatilized, but they are not calcined or vitrified: so it is employed to refine silver and gold, to destroy any accidental impurity.

## DCCCLXIV.

Another circumstance is, that they resist the scorifying



power of lead. Different metals, heated in this manner, are calcined more or less quickly. These having little attraction for oxygen, most strongly resist the action of lead. But there are none of them but what may be converted into scorizæ in this way, except gold and silver; these always remain the same, with whatever quantity of lead we perform the operation. If the mixture is exposed to a scorifying heat, it is the lead which scorifies it, being converted into litharge, and separated, until nothing but the gold and silver remain perfectly pure, without any loss. In consequence of this property of gold and silver, very small quantities of it, (two drams,) can be separated from 100 lb. of lead: the whole lead can be scorified.

## DCCCLXV.

Upon this is founded the manner of refining these metals, called cupellation. This is a putrefaction of them by means of lead in the cupel, which is made considerably thick, and of a spongy texture, and composed of materials which are not melted by the oxyd of lead. The gold and silver to be rectified are mixed with a quantity of lead several times exceeding the gold and silver, according to the quantity of impurity they contain; and, exposed to a scorifying heat, the lead brings on the scorification of the other metals, and the calceæ easily sink into the pores of the spongy vessels, which are compacted in a mould by the stroke of a hammer; but it has no clay to give it hardness or compactness, so they sink into the pores as water would do in a mass of chalk. And as the lead is converted into litharge, and the other metals into scorizæ, the whole is absorbed; while the silver and gold remain per-

fully pure, the cupel is tinged of a yellow colour ; it will drink in about twice its weight.

## DCCCLXVI.

*Silver.*

The appearance and more obvious qualities of silver are sufficiently known. It is less liable to rust than most other metals ; it is liable to tarnish upon the surface, not the effect of oxydation, but occasioned by an attraction of matter or effluvia, rather than separation of any thing, at least from the method of removing it, by making it red hot ; and by the circumstances which bring it on, we are induced to imagine that it is occasioned by the adhesion of a quantity of sulphurated hydrogen. It acquires this tarnish when it is exposed to the steams of putrid substances, or to the subtile vapour arising from solutions of sulphur. It is observed by silversmiths that the heat of the sun is attracted by it.

## DCCCLXVII.

It requires a strong heat to its fusion. When fused it looks like mercury, the surface is bright and clean ; and when the silver turns again to a solid state, it is liable to start out into a number of branches, with a kind of explosion, called the vegetation of silver ; that which is most highly refined is most liable to it ; so it happens frequently in the cupel after the lead, &c. is separated : it is occasioned by a sudden start of congelation. It is liable to retain a quantity of latent heat after its sensible heat is diminished below the point at which it begins to congeal, just as water can be cooled below frost, and remain fluid ; and upon some accident disturbing it the congelation happens with a start, with the same rapidity

that this congelation happens in water; and the external crust being suddenly congealed, and compressing the internal fluid parts, these get out, and are cooled by the air rushing out into a number of trunks, which start out from them at the same moment.

#### DCCCLXVIII.

Several of the active salts afford it oxygen, and dissolve it. The sulphuric acid acts upon it as it does upon copper, and it must be applied strong, with a boiling heat, when the silver is corroded, and forms a substance of little solubility, or sulphate of silver.

#### DCCCLXIX.

The nitric acid is the most perfect solvent of silver, when it is properly diluted with distilled water. There is a gradual separation of nitrous gas, and it forms a solution which turns out perfectly limpid and colourless; and when the silver is perfectly fine (in common silver there is a quantity of copper mixed), this solution has a remarkable quality for giving a black stain to many substances, particularly to animal and vegetable substances. The least drop applied to the skin, nail, or hair, soon produces a black stain; and hence it is used for staining hair, when it is largely diluted with water, giving a brown or black colour, according to the quantity. This stain is so durable, resisting the injuries of the air and other substances, that there is none more so; and it is now employed for marking linens before they are sent to the bleach-field: it supports the action of bleaching without the least diminution of its dark colour. It is observed to give a stain of this kind to some stones, as marble, agate, jasper, &c. The marble contains a calcarious

which may attract the acid; but these other stones are stony; yet it finds subtle crevices, and lodging in them, assumes the black colour. It is produced by the attraction of oxygen, when the solution is exposed to the air, in consequence of its decomposition; for it never will appear if it is preserved in a perfectly dark place. We can even contrive to shew the effect of the oxygen more evidently, if a paper stained with it be put so that one part is exposed to the air, and the other covered up; that exposed acquires the black colour, while the other remains colourless. The operation of bleaching has rather a tendency to increase the blackness of the stain, and the only means of taking it out is by the application of nitrous acid itself, which with a gentle heat dissolves the metal again, and occasions the stains to disappear. This solution readily affords white crystals.

## DCCCLXX.

The lunar caustic is made by melting these with a gentle heat, in order to unite them into one mass, which is cast into long rolls. If a stronger heat is used than is necessary to bring the mass into fusion, the acid may be separated; and it separates more readily by applying this compound to inflammable matters, as burning charcoal. Chemists have studied the art of separating the silver from the acid, so as to avoid any loss of the metal.

## DCCCLXXI.

Besides the nitric acid, silver is combined with the muriatic. This acid does not act upon it in its metallic state; but it exerts a strong attraction to its oxyds, and particularly when added to nitrat of silver. Thus it

will desert any other acid to unite with the muriatic; and in whatever shape the acid is presented, with earth, chalk, &c. it always unites with the muriatic acid, and forms a compound perfectly insoluble in water, as appears in the form of a white powder: so silver in the nitrous acid proves the nicest test of muriatic acid in a mixture, and the muriatic acid is a nice test of the presence of silver in a mixture. This compound is called *luna cornea*, from the appearance it has to horn when melted. Melted in a dark place it forms a transparent substance, and when prepared with attention and care, it can be made almost as transparent as glass. It has at the same time a degree of flexibility; so upon this account too it has been thought to resemble horn. The acid and silver adhere strongly, and are not separable by heat, in the lowest degree of red heat. If the heat is raised higher, a part of the compound evaporates, and it penetrates through the bottom of the crucible, and the greater part is lost.

## DCCCLXXII.

The silver is separated from these acids by alkaline substances, by different processes, and also by the greater number of the metals. Copper is the most convenient, and is commonly employed. The surface of the copper is covered over with a down of silver, in its metallic state, like little scales adhering to the copper; the silver is thus readily precipitated. A little copper unites with the silver, but this is no disadvantage in business. The nitrous acid is recovered from the copper by heat more readily than from the silver. If our purpose is to recover the silver, fine mercury would be better; for this being volatile, it might be entirely separated, but mercury

precipitates it more slowly ; and as purity is not aimed at, we are under no temptation to follow this method. But the experiment is amazing, in consequence of some phenomena attending it. When the solution of silver is diluted, the mercury for some time lies at the bottom, without any change, and is dissolved into an amalgam not different in appearance from the pure quick-silver ; but at length it comes to crystallize ; for the amalgams, when a certain quantity is united, are disposed to a sort of crystallization. In this case it is very remarkable and shining, shooting out branches, which rise to a considerable height in the glass, and having other branches issuing from them, like the division of common broom ; this is called arbor diæne, the experiment is among those which are the most precarious in chemistry ; the success depends upon the strength of the acid, the dilution of the silver, and the quantity of mercury added. The mixture must not be disturbed ; and it requires about six days, or a month, to complete the crystallization.

## DCCCLXXIII.

The chemists would have combined it with the muriatic acid, had they known the way of recovering it without loss. There is no method of having it so pure as by making it into a luna cornea, and recovering it by cupellation ; a minute quantity of copper, however, is left, which the lead has not power to scorify, being defended by the silver ; but when precipitated from aqua fortis by means of muriatic acid, if there be copper in the solution, it remains dissolved ; only the silver is precipitated ; but to recover the silver by cupellation is attended with great loss, in consequence of the volatility and penetrating nature of these substances.

## DCCCLXXIV.

When this metal is combined with sulphur it forms a mass resembling lead, only of a duller colour, but with some degree of softness, and it bears the impression of the hammer. The silver is combined with the sulphur by granulating it, by pouring it into cold water, and mixing the fluor of sulphur, which melts and penetrates the silver, and forms a very fusible compound. The sulphur can be separated by heat alone, or we may separate it by the addition of other metals, many of which attract the sulphur more strongly, though silver is one of those which have the strong attraction for sulphur; so it is used for refining gold.

## DCCCLXXV.

It unites also readily with the other metals, particularly it has a strong attraction for lead. If it is mixed with iron, the lead attracts the silver from the iron. The other metals diminish its ductility and malleability, except gold and copper. The copper, in small quantity, gives more firmness and elasticity to the silver, so is added to it in plate, in the proportion of one part to about 12½ of silver.

## DCCCLXXVI.

The chemists have studied more the art of separating silver from other metals than that of combining them. It is worth while even to extract small quantities of it from other metals, when mixed with the ores. This is done by different trials, according to the nature of the metals. If it is mixed with mercury it is separated by heat, or by squeezing the amalgam with leather, and the remainder is decomposed by the application of heat, which converts the mercury into vapour. It is separated from all the

rest, except gold, either by scorification or cupellation with lead, where the silver is mixed with brass, consisting of a perfect and semi-metal, when we must perform both these operations, which are distinguished in this, that they are both done by adding lead and applying heat, till a quantity of the lead is converted into litharge; but scorification is performed in a vessel which does not imbibe it, so that the scoriæ gather till they have acquired a proper degree of thinness to allow the particles of silver to be attracted at the bottom; then the operation is stopped, and the calces of the other metals acquire a certain quantity of the calx of lead, to bring them into a state of fusibility, according to their degree of fusibility. Thus the calx of iron requires a great deal. When any of these are in the composition, it is proper first to scorify the mass, that the scoriæ may be brought to a certain degree of tenuity, to allow them all to gather to the bottom, and a great deal of lead remains, in its metallic state. To collect these this mixture is taken out and cupelled, by means of which the lead and copper, or other metal, is scorified and imbibed by the cupel, the fine silver remaining. When a small quantity is to be refined, it may be melted with nitre; but this volatilizes a part of it, and it is expensive for large quantities, as the nitre is totally lost, whereas the lead can be recovered.

## DCCCLXXVII.

When mixed with gold it can be separated only by means of aqua fortis, or aqua regia; the one dissolves the silver, and leaves the gold; and the other dissolves the gold, and leaves the silver: but we have it purest by



adding aqua fortis, the aqua regia having a minute portion of gold.

## DCCCLXXVIII.

With regard to its origin, it is found in all countries, but most plentifully in Peru, in South America. There is a very little of it in Britain; it occurs either in its metallic state, or in the state of an ore, or in the ores of other metals. It is found in little filaments or branches, like the leaves of plants, bedded in hard stones, or among the ores of silver, which contain it as their chief metal.

## DCCCLXXIX.

It is not necessary to fuse the silver in its metallic state, the mineral is broken down into fine powder; the masses of silver do not easily divide, but retain their size; so they do not pass through the sieve, and any small particles which do pass through are afterwards separated by washing, setting the earthy particles afloat, and allowing the metal to subside; but mercury is found to be of use: it is always put into the vessel, and a gentle heat sometimes applied; it attracts the metallic particles, collects them at the bottom, and they are never set afloat again. The mixture of silver with mercury is very remarkable, on account of its turning out remarkably heavy, though mercury is more heavy than the silver. This method is very much practised in Peru.

## DCCCLXXX.

When silver is found in the state of an ore, it requires other operations. The more remarkable ores are; 1. The *minera vitrea*, which is a compound of silver with copper; 2. The *minera cornea*, which resembles the luna

corner, and is supposed to be a compound of silver with muriatic acid; 3. The *minera rubra*, which is of a deep red colour, with some transparency, and often appears crystallized. These differ in this, that the *minera cornea* is flexible, while the *minera rubra* is quite brittle but very fusible, melting at the flame of a candle like wax or resin. It is a compound of silver with arsenic and sulphur, and hence its colour. Authors mention a *minera alba*, but this is more properly an ore of copper in which the copper is combined with arsenic, though the quantity of silver it contains is much more valuable than the copper; so it is considered as an ore of silver.

## DCCCLXXXI.

It is separated from all these ores by scorification and cupellation with lead; it is separated from the earthy matter by elutriation, and the remainder is heated with lead in a hollow forge; the sulphur and arsenic unite with a portion of the lead, and promote the scorification; the metal is attracted by the melted lead at the bottom, while the litharge brings into a state of fusion the remains of the earthy and stony matter; so the *scoriae* allow all the metallic particles of the silver to be united with the lead. The cupellation is managed in the large way, in a cupel of a large size, (of some feet in diameter,) heated in a furnace, of the form of an oven; at the same time two pair of bellows are made to play upon the middle of the cupel directly, and the wind of them is made to play with a sort of agitation, by means of a little plate of iron placed before the nasal of the bellows, which forms its elasticity, occasions a tremulous motion in the stream of air, by which the litharge is blown off to the opposite side, where a gutter is made to allow it to run out of the furnace, by

which means large quantities of lead are easily converted into litharge.

## DCCCLXXXII.

Besides it is often contained in small quantity in the ores of other metals, and is separated from them by different operations, according to the nature of these ores. The ores of this country, though but few, contain enough of it to be worth the working for silver. In England it is found in the quantity of one pound in 100 lb. and in a less proportion than in this country.

It is also contained in the ores of copper, from which it is separated by means of lead.

## DCCCLXXXIII.

*Gold.*

This is called *sol et rex metallorum*. When quite pure it has no elasticity; the finest kind bends backwards and forwards like a bit of lead, and it is the least sonorous of the metals. Its great ductility was taken notice of, and its great density and weight are always well known; but it is the least fusible of the metals, requiring a white heat. It never undergoes any change in the fire; but it soot, it always becomes bright. It withstands the action of heat and air, though mixed with lead. Though the most intense heat was never known to alter pure gold, yet there are some metals which mixed with gold promote its calcination, as mercury and tin. In these mixtures the gold is very brittle, and it would seem that the melting of gold requires some care to prevent it from being brittle, either from a want of a sufficient heat to make it perfectly fluid, or from its being suddenly cooled, this effect is produced, and it has been imputed to the

contacts of fuel ; but it chiefly depends upon these two circumstances, and sometimes too it depends upon a very small quantity of metallic matter, especially tin.

## DCCCLXXXIV.

None of the acids, applied pure, produce any change upon it, even in their most concentrated state. The only one that decomposes it, in its metallic state, is the oxygenated or nitro muriatic acids. The gold dissolves slowly ; so it is proper to increase the surface of contact, and to apply a moderate degree of heat, when it will act with a sensible degree of effervescence, and the eruption of nitrous gas.

## DCCCLXXXV.

The muriat of gold is easily decomposed by the fixed alkalies, lime, and magnesia. The precipitate is of a yellow colour. When ammonia is used a peculiar precipitate is formed, and is known in chemistry by the name of aurum fulminans, from its exploding with extraordinary violence, when heated. It is of a dull brown or yellow colour. By evaporation it affords yellow deliquescent crystals, or muriat of gold. It consists of a compound of ammonia and oxyd of gold. It sometimes requires to be heated to a considerable degree before it takes fire ; but if we touch it before this, or apply the smallest degree of friction, the explosion is immediately brought on. During the explosion the gold is restored to its metallic state, there is a stain on the paper of minute particles of gold ; and covering the gold with a glass receiver, the metal is dispersed over the surface of it, and in its cavity, in its metallic state : so this preparation is in danger of hurting people, and melancholy accidents have been occasioned

by it, from too much heat being applied to it, or from friction, by being bruised in a mortar, and the water warm, &c.

## DCCCLXXXVI.

From this view of the nature of the aurum fulminans, we can understand how several substances come to deprive it of its exploding power. The volatile oils, or the others, added to the solution of muriat of gold, attract the oxygen of the oxyd, and the metal being diffused through the liquor, in particles of great tenuity, communicates to it a rich yellow colour.

## DCCCLXXXVII.

The muriat of gold is also decomposed by other metals, from their stronger attraction for oxygen than gold. The most remarkable of these is the precipitate obtained by the solution of tin. The tin is dissolved by means of the nitro muriatic acid, and a very minute quantity of gold in solution is put into a glass of water, so as to give it a barely sensible yellow tinge. On adding somewhat more of the solution of tin, there is a dark purple colour appearing in the mixture, which in a little time assumes a brighter hue, and will become a pleasant and rich purple, similar to that of red wines; and allowing the mixture to stand at rest, the gold will be gradually deposited in the form of a purple precipitate. This is valued as being a very useful colour in enamel painting, retaining the colour well in the fire, which is a great property in colours used in enamelling. It is also celebrated as a preparation of gold; by means of which glass may be tinged of a transparent red colour, which is an art that has been professed by few chemists. At present it is sold, made into

tubes, which have no sensible colour; but on applying the flame of a candle or lamp, the rich red colour appears. It is said when the gold is dissolved by the ingredients of the glass, it at first disappears entirely, and becomes visible by exposing the glass, in its soft and melted state, to the flame of wood, or by throwing in nitre or muriat of ammonia. The other metallic solutions which precipitate it best are the solutions of sulphate of iron and nitrated mercury, which are employed occasionally.

## DCCCLXXXVIII.

Gold is not disposed to unite with sulphur, but it can however be dissolved if the sulphur is combined with an alkaline salt, or sulphuret of potash. This solution takes place with some degree of violence, when the gold is thrown into it melted, and the gold, when recovered, appears purer than ordinary.

## DCCCLXXXIX.

This metal is liable to a change of its colour; but it is also of many different colours, sometimes it is redder, sometimes of a greenish cast, sometimes pale, perhaps from an admixture of sulphur; but the greenish and red colours are by means which are kept secret.

## DCCCXC.

In studying the relation of gold to other metals, there are none with which it mixes more readily than quick silver. The gold, being made into plates, readily forms an amalgam with it, which feels gritty, and in gilding it is diffused with more mercury, and made to adhere; and the mercury evaporating, leaves the gold adhering to the surface. Mercury is used in this way, occasionally for

making a ring brittle, when sticking upon a swelled and inflamed finger, and the stroke of a key, or the like, will make it fly in pieces. All the metallic substances mixed with gold render it brittle, and spoil its colour, except copper. But as gold, in its purest state, is very soft, and rather unfit for vessels, there is a small quantity of these metals added, to give it more firmness, particularly copper, and the quantity of this addition is regulated by law, and the legal alloy is about  $\frac{1}{12}$ . Or they use a mixture of copper and silver, which rather heightens the colour, whereas silver alone produces a sensible paleness. The fineness is denominated in carats; a carat signifying the twenty-fourth part of the weight, whether it is a pound, ounce, or grain: so the fineness is denominated by the number of 24 parts of pure gold the mass contains. If the whole is pure, it is gold of 24 carats fine; if there is  $\frac{1}{12}$  of alloy, it is gold of 22 carats fine.

#### DCCCXCI.

The operations by which the gold is tried, or refined, from the admixture of other metals, are reckoned five.

1st, The touch-stone. It is but a rude extemporaneous trial; it is a stone of a black colour, which does not dissolve in acids, and is ground into a rough surface. When a bit of gold is rubbed upon it a metallic line is left. They use it in order to observe the colour of that line, as gold of different degrees of fineness produces a difference of colour, and they can judge in some measure in this way. Further, they have a number of little plates of gold, all marked, to denote the fineness: so having formed some judgment with this stroke, they draw another line with the plate which they suppose to be equal

in fineness, and observe if the colour is the same. If it is not exactly the same they draw another stroke with another plate, and so on till they get the colour to agree. But this trial by the colour is deceitful, as the colour varies as the gold is mixed with silver or copper, or with both of them.

## DCCCXCII.

Another use therefore of the touch-stone is to know whether it be really gold, or if it contains a large quantity of gold; so drawing a stroke or two, they apply aqua fortis, which will not touch the gold; but if it is any metal in imitation of it, the aqua fortis is sure to dissolve it: so they judge by the stroke disappearing or growing much fainter that there is such a mixture. However it is only an extemporaneous means.

## DCCCXCIII.

The operation by which the gold is actually refined is either cementation, the operation with crude antimony, cupellation, or aqua fortis.

Cementation is an application to gold of either the nitrous or muriatic acid in the state of gas, or in dry and burning hot vapours, with common salt or brick dust. The gold is beat into thin plates, and put into a crucible with alternate layers of salt and brick-dust, to prevent the salt from coming into fusion, and some calcined vitriol. The acid, separated in dry and burning hot vapours, penetrates the gold, and separates any impurity which can be washed off by water; but this method is now much out of use, for it is imperfect; as these vapours act only upon the surface, they do not penetrate deep; and, to refine the gold highly, we must melt the little plates



all together, make it again into plates; and thus we do the same operation two or three times.

#### DCCCXCIV.

The method by crude antimony is more frequently used. The impure gold is melted with it, and the sulphur of it immediately unites with any other metallic substance, silver not excepted, as there are none of them but what attract the sulphur more strongly than the antimony does; so these, united with the sulphur, form a slag, or scoriæ, which arises uppermost; and breaking the vessel, we find at the bottom the antimony and gold, which being collected together, the antimony is easily volatilized or dissipated by heat, so as to leave the gold quite pure. The metallic mass is melted in a crucible, and kept melted with a red heat, the blast of a pair of bellows is directed upon it, and as soon as the white smoke disappears, we are sure it is well separated.

#### DCCCXCV.

The most useful operations are cupellation and aqua fortis, which naturally succeed one another. In the first of these a quantity of lead is added and some silver, and the mass is heated in the common way of cupellation; the lead is scorified, and any coarse metals are oxydated. In this operation some silver must be mixed with the gold, otherwise it will not part with its impurities; it will retain a small quantity of copper, and even of the lead, at the end of the operation.

#### DCCCXCVI.

The necessity of adding silver, in order to make it part with these impurities, occasions the necessity of the following operations of aqua fortis or aqua regia, according

to the proportion of metals. If aqua fortis is used, the quantity of silver must exceed, otherwise the solvent will not readily extract the silver. Again, if we use aqua regia, the quantity of gold must exceed, or the solvent will not readily dissolve the gold. The success of the operation too is a little different, according to the acid used; if it is aqua fortis it leaves a minute portion of silver adhering to the gold, at least this is said, although later experiments do not altogether support this notion. If aqua regia is used, it leaves a minute quantity of gold adhering to the silver; so we must use the aqua regia to have the gold fine, as it will dissolve none of the silver, but precipitates any part dissolved by the nitrous acid. The dissolved gold has been recovered by precipitating it with mercury. These are the operations, till of late, found sufficient for the refinement of gold. But not long ago a new metallic substance, platina, was discovered, which cannot be separated from gold by any of these means. It has not the colour of gold, so is not to be tried on the touch-stone; but it withstands the nitric and muriatic acids, and the operation of cementation; and being capable of being dissolved into sulphur, it withstands the operation of crude antimony. It endures, without loss, the action of lead, and is not dissolved by aqua fortis; but like gold, in aqua regia. But we have discovered methods of separating these two metals from one another, which shall be noticed under platina.

## DCCCXCVII.

When gold is contained in small quantity only, the process is somewhat different. It is separated from all other metals, except silver and copper, in the same man-

ner as silver, by scorification and cupellation with lead. But the gold is mixed with a large proportion of copper, perhaps one ounce in the hundred weight; in consequence of the particular attraction between the gold and copper, the lead does not extract the gold. But a method has been found in Germany of extracting it with great profit, which is by separating the copper; the copper is reduced into small grains, by pouring it, in its metallic state, into water. This mass being afterwards melted with the oxyd of lead, readily affords the gold it contains. The lead now separates it easily from this mass.

## DCCCXCVIII.

When it is mixed in small quantity with silver, the operation is different. It is not worth while to dissolve it in aqua fortis, as the quantity requisite is very great, and the expence greater than the quantity of gold obtained. Sometimes the gold is upon the surface, as in gilt works; when it is equally diffused the silver is combined with sulphur, and the gold separates spontaneously; there is a quantity of silver at the bottom unchanged, the rest being combined with sulphur.

## DCCCXCIX.

With regard to the origin of gold, the scarcity of this metal is the chief reason of the high value put upon it, though it is produced by nature in much greater quantity than is imagined. It is found in the Brazils, in the Spanish West Indies, in the East Indies, on the coast of Africa in large quantity, and in some parts of Europe. There are mines of it in Upper Hungary, which have yielded it for these ten centuries, and there are several rivers in France, the sand of which contains gold; and in

this country gold was found in the soil in the neighbourhood of rich lead mines, and was extracted with profit when it was more valuable than it is now. From the accounts of travellers who have visited the mines in America, we learn that gold is sometimes found in veins, like other metals, but is more generally found in the sand of rivers, mixed with the rubbish of mountainous places and sand, with particles of quartz adhering to it, and is always found in its more metallic form, though containing a little silver, iron, and arsenic; but it is never changed so totally by the combination of sulphur, iron, and arsenic as the other metals. It is found in grains, in different sizes, some considerably large, weighing some pounds; but commonly in very small particles or films.

## DCCCC.

As gold, in its metallic state, is a very ponderous substance, the manner of extracting it is generally by elutriation. When the particles are tough, and do not readily divide, they are prepared for pulverization by fire, heat making the gold more dense and compact. You will find in Agricola, an author of great merit upon the subject of metallurgy, methods of washing gold, and other ponderous minerals. In some of the countries where the gold dust is rolled along the rivers, it was a practice to put sheep skins in the course of the water; that the heavy particles might sink into the wool, then the gold was washed out, and to this is imputed the story of the golden fleece; and in a paper of Reaumeur's, among those of the Royal Academy of Sciences, we have a distinct and pleasing account of the practice in France, for separating the gold dust in their rivers. It is done by the peasants,

who observe the little change the river makes in its channel, and when a bank falls down the lighter parts are carried away, and the heavier parts sink to the bottom, and in these places they find the greatest quantity of gold. In the neighbourhood of such places they lay a board sloping towards the river; this has a ledge upon each side, and upon that they stretch a rough woollen cloth; then over the board they suspend a basket, like a sieve, and they fill this with the sand and rubbish; upon this they pour a quantity of water, which carries with it the small particles of sand, and the gold too, in small particles, while the gravel and coarse rubbish remain in the basket. This operation they repeat till the basket is quite filled with the heavier particles of the sand. They then wash it with water till they have collected a large quantity. This they wash farther in shallow wooden vessels, giving the sand and water sudden motions and jerks, to make a quantity of it fly over, and thus they free the gold from the greatest part of the sand.

#### DCCCCf.

In these parts of the country where the gold is found, Strangers often have their curiosity fulfilled by the inhabitants, who gather a quantity of loose rubbish and gravel into a shallow wooden trough, and stirring all the parts with their hands, till they take out all the large stones, leaving only a pretty small gravel; and adding water to this, and agitating the vessel, they bring the coarser parts to the top, and scum them off, while the heavier matters is left behind, and from one hundred weights, perhaps, they generally obtain two or three particles of gold, but so minute that they require a microscope

to see them distinctly. It seems to be the case every where that it is dispersed, in minute quantity, through a large proportion of other matter, so that the time and trouble bestowed upon it is but ill repaid by the yield of gold; and from the accounts we have of the mines in the Spanish West Indies, the yield of gold from large quantities of matter is but very moderate.

Sometimes the operation is finished by mercury, which forms an amalgam with gold, which is more easily perceived and in less danger of being set afloat by the water; but it never acts completely in extracting the gold.

## DCCCCII.

*Platina*

Is a metallic substance which withstands all the trials formerly thought sufficient to ascertain the purity of gold. This metallic substance was first brought into England from Jamaica in 1749, and was first brought to that place from the Spanish West Indies. The origin of the name is plainly from some resemblance it bears to silver, being a diminution from *plata*, which signifies silver in the Spanish language. A specimen of it was presented to the Royal Society, and since that other specimens have been imported into other parts of Europe, and it has been particularly attended to by several able chemists.

## DCCCCIII.

The appearance of this metal is such that a person not much accustomed to view iron filings would take it for them, but the colour is a little brighter. It is in small grains, and ponderous: by far the greatest part, viewed by the microscope, consists of these grains flatted and

smoothed at the edges. But there are other substances intermixed with these, as a small quantity of blackish dust, which is attracted by the magnet; so it is an ore of iron, or iron sand. Besides, there are generally small particles of gold and a little mercury, some quartz, and sometimes matters resembling pit-coal; hence it has been concluded that it is a matter from which gold has been washed. It is probably mixed with the sand from which gold has been extracted, and the small particles of gold and mercury shew that mercury has been employed to extract it.

## DCCCCIV.

It is of an extraordinary weight, nearly approaching to gold in density. The purer particles are 17 times heavier than water, and some of them 18 times, and gold is hardly 20 times the weight of water. The larger grains, tried on the anvil, shew but a small degree of malleability, and it was considered as a semi-metal; but the want of toughness proceeds from its impurity, and it is as tough as gold or silver, but is remarkably difficult of fusion. Those who first examined it tried it by strong fires, and increased them gradually till they melted their crucibles and furnaces, and still it never united together. It seemed to be united, but striking it with the hammer it immediately divided into as many grains as composed it at first.

## DCCCCV.

In all these trials it withstands the action of heat, as well as silver or gold; so it deserves the name of perfect, or noble, as much as they do: and as it is unchanged by heat, so it stands the action of nitre, and other agents; by means of which the other metals are oxydated and

scorified, as lead, which does not contain it; nay, after the greatest quantity of the lead is separated, a portion of it is retained and defended by the platina, so that we cannot scorify it completely.

## DCCCCVI.

In these respects it resembles the perfect metals. Sulphur does not act upon it when combined with antimony; it is only dissolved by the sulphurets, and that only in small proportion. When antimony is mixed with it, it may be evaporated without the least loss, nay, it retains a portion of the antimony, and defends it from the action of the heat and air. The nitro muriatic acid produces a solution of a strong yellow or reddish colour, deeper than the solution of gold. This solution, however, differs from that of gold in several respects. The alkaline salts precipitate the platina completely, particularly the fossil alkali, which does not precipitate gold in the smallest degree; and these subtiler liquors which occasion the precipitation of gold, spirit of wine, æther, and the oil of rosemary, which separate the oxyd of gold from water, have no such effect upon platina: it is therefore plain that the notion which some people took up, of its being a mixture of gold with some other metal, is false. With copper it forms a metal of a moderate toughness, which does not tarnish in the air; with iron it forms a metal of extraordinary strength and hardness, having the hardness of cast iron, with a great degree of brightness, which cast iron wants.

## DCCCCVII.

When added to gold it produces a metal more useful to painters in enamel. They are obliged to use pure



gold, as the matter in which their colours are laid is more apt to throw off the crust of enamel; but it is a soft metal, and easily bent, and it melts rather too soon in the fire, not easily enduring the heat necessary for vitrifying the enamel on its surface. Platina may be mixed in certain proportion with gold, so as to constitute a metallic mass, which cannot be melted but in a very violent fire.

## DCCCCVIII.

The relation of gold with platina has been studied, on this account, that when it was imported the working of it was said to be prohibited in the Spanish West Indies, on account of the difficulty of distinguishing it from gold, the mixture withstanding the usual trials, so that it may be made to pass for pure gold. In order to learn if this apprehension was well founded, it has been mixed with many proportions of gold, but the colours were always found greatly altered.

## DCCCCIX.

Scoffer dissolved the mixed metal in aqua regia, and added a solution of green vitriol, or sulphate of copper; as the gold is precipitated by solution of other metals, if they are not combined with the muriatic acid. In consequence of the strong partiality they have for the muriatic acid, they take it from gold, and the gold necessarily precipitates with the other acids; so upon adding the solution of green vitriol, or sulphate of copper, Scoffer was assured that the gold was completely separated, and not the least particle of platina was separated.

## DCCCCX.

The fossil alkali which precipitates gold more effectually

than any other, as in the aurum fulminans, has not the least effect upon the solution of platina. Mercury, when added to this solution of gold, dissolves a portion of it, and the gold is precipitated in its metallic form. When the same mercury is added to the solution of platina it is not dissolved, nor occasions any precipitation of the platina, so that this may be an effectual method of separating these metals occasionally from one another. A solution of sulphate of iron also precipitates gold dissolved in the muriatic acid, but has no effect on platina.

## DCCCCXI.

*Cobalt.*

This mineral has been long known, and when first extracting a metal from it they called it regulus or sulphuret of cobalt. It contains a large quantity of arsenic, and the only use made of it is to extract arsenic from it. The oxyd remaining after the evaporation has the effect of tinging the clays of a rich blue colour, which is very durable in the fire. It is with this substance that the blue decorations of porcelain, and other earthen ware are performed, and the transparent blue colour of glass.

## DCCCCXII.

The arsenic is separated by roasting it in an oven, when the steams are directed into a long vent at the side of a mountain, so that the condensible parts are gradually condensed, and they are afterwards scraped out and refined. Upon the floor of the oven is found a brown coloured oxyd, which melted with glass gives it a blue tinge; the glass is afterwards ground to a fine powder called smelt blue, and is used for bluing linen, or it is mixed with flinty matter, as quartz, and sold by the name

of zaffre, and the manufacturers of porcelain and delft ware purchase it to decorate their ware.

This passed long for a mineral substance allied to the metal, till some of the Swedish chemists obtained with inflammable substances a metal of a whiteness approaching to that of silver, but quite brittle when it is struck with the hammer, and they called it regulus or sulphuret of cobalt.

### DCCCCXIII.

The most remarkable qualities of it are, it dissolves in acids, so as to produce a solution of a reddish or rose colour. A solution of this kind is best obtained by adding to nitrous acid common salt; the nitrous acid unites to the alkali of the common salt, and the regulus of cobalt unites with the muriatic acid, forming such a solution as we obtain by adding the oxyd to pure muriatic acid; and though this is red, if it is heated, it acquires a green colour, especially when evaporated to the state of a salt, when it is made to afford a sort of crystals of a red colour, but which become green on being warm; so it forms an amazing sort of liquor, which becomes figures of a pale red, or which are hardly visible; but by being warmed, become green, or of a pale blue colour.

### DCCCCXIV.

The sympathetic ink is produced by cobalt as well as bismuth; these two are often mixed together in their ores. But taking bismuth perfectly pure, it does not produce a liquor of this kind. If a drawing with this liquor is approached to the fire, the red colour gradually changes into a pale greenish blue, which appears to depend upon the evaporation of humidity from the saline compound upon the

paper. This change has been imputed to heat ; but after the stain has been changed in this manner, if it is exposed to humidity, or merely laid by, it returns to its former state, and the sooner the more humid the air is ; so breathing upon it makes it disappear much sooner than it would otherwise do.

## DCCCCXV.

*Nickel.*

Nickel is of a reddish colour, resembling that of copper. The metallurgists have been long accustomed to the knowledge of that ore, and were disposed to expect copper from the appearance ; but finding none, they gave it a sort of nickname, implying that it has none, they called it, *good for nihil*, and this was contracted to *nickel*. In this mineral the metal is always combined with a large proportion of sulphur and arsenic, and sometimes iron. When it is rendered pure, it is a white metallic substance, but with a reddish cast, and it is perfectly brittle. The most remarkable qualities of it are, that by long calcination it is converted into an oxyd of a green colour ; at first it is dark, but continuing the calcination it is green, and it resists the action of other substances which are powerful in bringing different oxyds into a state of fusion ; so in these cupels used to essay minerals with lead containing some sulphur and some nickel intermixed ; as soon as the lead began to scorify, the nickel was thrown to the external edge of the melted lead, but it stuck there ; all the litharge had not the power of bringing it into a state of fusion ; so in this respect it differs from all other metals.

## DCCCCXVI.

Copper, oxydated by fire, produces an oxyd of a dark

colour, or with a reddish tinge, and when this is combined with acids it produces a green solution which can be made to afford a sulphate of copper; and as nickel does very much the same thing, it is therefore probably one of the circumstances which has made the chemists expect copper in the mineral containing it.

#### DCCCCXVII.

This metal is further distinguished for having a strong attraction for sulphur, possessing a greater disposition to unite with it than any other metal. It unites with it more readily than with iron, and retains it in the fire more strongly, at the same time it is remarkable for not mixing with silver: in whatever proportion they are applied to one another they separate again when brought into perfect fusion; the silver and nickel are found lying in the same plane perhaps, and in close contact with one another; but the least stroke separates them. It has been thought that it might be useful in separating sulphur from silver without communicating any taint to it. It is so difficult to obtain nickel pure that it is not worth while to have recourse to this method: but there are several other methods for separating sulphur, as the adding half its weight of the caustic alkali, and melting the mixture; so there is no use to which this metal can be applied. It has not been tried much in mixture with other metals, at least it has not been found to produce any useful compound. It has been tried if the green oxyd would produce a colour useful to the painters, but the colour is not so intense and bright as to answer their purpose.

#### DCCCCXVIII.

The metals are a class of bodies only a few of the in-

dividuals of which have been applied to the purposes of medicine. These few, however, afford remedies very active and powerful, and of extensive and varied operation. As all metals have been found to act on the body most powerfully in the form of oxyd ; from their oxygen alone the principle of their action has been deduced, and their identity with acids in the mode of their operation conjectured ; but when the subject is fully examined, although we find part of their effect is certainly to be attributed to the proportion of oxygen they possess, this by no means exhausts their properties, and something remains to be ascribed also to the base with which the oxygen is united. Hence though the acids suspend the progress of a disease, they by no means complete its permanent removal ; and though they are much quicker in the progress of their influence in subduing the morbid action for the time, yet the latter, we find, is apt, at last, to spread its ravages in spite of their application ; a proof that oxygen alone is not sufficiently permanent to counteract it.

Would the metals, if they were soluble in the animal fluids, be totally inert, should they be deprived of their oxygen ? I apprehend not ; and, if so, why should their qualities be ascribed to their oxygen alone ? Much advantage, however, has been derived from a knowledge of this principle in their combinations ; and by this knowledge we find the means of regulating their powers, in a manner much beyond what former practitioners were acquainted with. The faults of modern experimenters is the same with that of all theorists, a desire to simplify too much, and to admit the operation of one principle alone, where there is reason to think that several concur. In medicine

this is particularly the case, and we find peculiar combinations successful in the removal of certain symptoms, without being all from the analysis of these combinations, to account for the principle of their operation.

### DCCCCXIX.

The first, and most important, of the metals in medicine, is mercury; and its exclusive infallibility, or nearly so, over the venereal disease, as well as its utility in a number of others, renders it the most valuable discovery that medical chemistry ever brought forward. Mercury is always applied in the form of an oxyd, and its oxydation takes place, as we have seen, either by triture, heat, or acids: we shall consider it, therefore, rendered active by each of these means, beginning with its highest oxydation, as that with acids.

For long after the appearance of the venereal disease in Europe, there were only three methods of treating it. The first was by frictions; the second, by gastric decoctions; and the third, by fumigations with cinnabar. Of these, however, the most general was by frictions; till chemistry coming into repute, such a rage took place, that none but saline preparations came to be employed; and by this form the mineral was supposed to have its virtues increased, or to be deprived of its supposed noxious qualities. From the effect, however, of these preparations, or rather the ignorance of physicians in their proper application, they have now come to be discarded, except a very few; the principal of which is the corrosive sublimate, forming at present the basis of many quack remedies in great repute. It was first proposed by Dr. Herman of Leyden to be used in the cure of the gonor-

rhoea. This dose was gr. ii. formed into a pill with liquorice; and he remarks, which was indeed necessary from the largeness of the dose, that its use should be confined to robust constitutions. Before his time, however, it had begun to be employed in London, for the same complaint, by an empiric, as we are informed by Dr. Turner, who gave it dissolved in spirit of wine. And his method was, to dissolve  $\mathfrak{z}$ i. of the preparation in  $\mathfrak{z}$ i. of spirit; and of this solution he gave his patient 10, 12, or 15 drops, in a quantity of barley-water, or any light decoction, so that his patient had but one fifth of a grain for a dose; a practice much more judicious than Dr. Herman's. Dr. Boerhaave next recommended this preparation; and, in his Chemistry, observed upon it, that gr. i. dissolved in  $\mathfrak{z}$ i. of any distilled water, proved an excellent cosmetic;  $\mathfrak{z}$ i. of which solution, taken twice or thrice a-day, and softened with syrup of violets, would do wonders in the removal of many incurable maladies; and by this practice  $\frac{1}{8}$  gr. made the usual dose every day. But this remedy, so strongly recommended by Boerhaave, was first brought into regular practice by his disciple Van Swieten, and its success established in the Lock Hospital at Vienna, by his recommendation of it to Dr. Locher, physician to this charity, who has published some very excellent practical observations on its use. It was next carried to France; but its success there was not equal to what happened at Vienna; and the French, indeed, have never been fond of employing this preparation. In Britain, the first introduction of it into practice was owing to the late Sir John Pringle. It was by him recommended to the notice of the army surgeons, and accounts of its success published in the Medical Transactions; from which it ap-



pears a medicine of very quick operation in the removal of venereal symptoms, being therefore well adapted to military practice. The method of exhibiting it recommended by Van Swieten was simply this: Twelve grains of the preparation were by him put into a matrafs with two pounds of ptyfan, submitting it to a gentle heat, and frequently shaking it, till the preparation came to be dissolved. Of this a table-spoonful was to be taken every morning fasting for 25 or 30 days; so that one grain came to be daily used; at the end of which period a cure was generally effected. But to this method of Van Swieten some objections may be made.

1. The diffusion of it, in such a quantity of watery fluid, does not allow its stay in the system to be sufficiently permanent. Hence we find the excretions of sweat and urine most frequently produced by it.

2. From its strong stimulant powers it possesses always a tendency to act in this way; which should rather, by the form of its exhibition, be repressed. Some authors therefore have very properly recommended, though it seems merely with the view of lessening its irritation on the *primæ viæ*, its use in a solid form. On this principle it was employed by Mr. Petit of Paris in the form of pills, giving to the quantity of half a grain a-day. In the same form Dr. Gairdner of Edinburgh has likewise used it, finding those inconveniences avoided which attended its operation in a diffused state. It was from the original manner then of using this preparation, that physicians remarked it seldom effected a complete cure, except in recent and slight cases, from wanting that permanence of action, or durability of stimulus, on which the specific suc-

cess of mercury in the extinction of this disease depends. Hence, in modern practice, they seldom trust to it alone; it being common to employ it either in the commencement of the cure, from its quick abatement of venereal symptoms, its distinguishing characteristic; or when frictions have been employed; so that towards the termination of the mercurial course, the absorbents of the surface tire of taking up the necessary quantity of the remedy, it is given suspended in some of the alterative decoctions in small quantity in order to complete the cure. It is this preparation which forms the basis of the *Maredant's* drops, of the *rob. antisyphilitique* and vegetable syrup of *Velno* in France; and wherever it is used in a fluid form, a proportion of *sal ammoniac* should be joined, which increases the quantity of it receiving solution.

But, besides the internal use of this preparation, attempts have been made to introduce it also from an external surface. The first of these, termed the *Lavemens Mercurielles*, was employed in France with a view to supersede the use of mercurial frictions. It consisted in immersing the feet in a strong solution of corrosive, and retaining them there for a considerable time, so that a proportion of it might be absorbed without affecting the *primæ viæ*. But the success of this practice, though effectual in some cases, could not always be depended on.

A treatise has been also published some time ago by a professor at Naples, recommending its introduction by frictions. The situation chosen for this purpose is the soles of the feet, the skin there being the thickest; and he directs that 3i. of the preparation be reduced to a very

fine powder, then mixed with ℥i. of axunge, which is to be triturated for the space of 12 hours, so as to produce an intimate union, ℥ii. of which are to be rubbed in each night; and he remarks, that in this way he has found it cure the most obstinate cases, which resisted every other remedy.

The next saline preparation in repute is calomel. It is much milder, in consequence of the mode of its preparation, than the corrosive; and while the latter shows a natural tendency to the skin and kidneys, it, on the contrary, always affects the bowels. It is the preparation in most esteem at Edinburgh next to the blue pill; but, from its particular tendency, it requires to be exhibited in small doses, except when it is meant to act solely as a mercurial purge. This tendency, however, is much lessened by joining it with soap. It has been generally supposed best adapted to recent cases, where there prevails some degree of active inflammation; for by its purgative property it operates here in some measure as an antiphlogistic: but there is such a variety in the preparation of this remedy in different countries, that it cannot be depended on.

#### DCCCCXX.

The saline preparations with the nitric acid come next in order.

Dr. Ward's white drop, like every other quack medicine, we are little acquainted with; but from the reputation of its inventor, by whom it was very generally employed, we may entertain some idea of its success.

Another medicine similar to it is La Motte's, formerly in much repute at Paris. It consists of a solution of red precipitate, or nitrated mercury, which gives it a bright

purple colour ; and a few drops of this, taken in a quantity of any diluent liquor, were generally reckoned a sufficient dose.

Charas's solution is a less active medicine than either of the former ; being the common nitrous preparation diluted with 24 times its weight of water. By this dilution a great part of the mercury precipitates ; but its author observes, that so much still remains, and in that highly oxydated state, as to prove a useful medicine.

The vegetable syrup of Bellet was at first in great esteem in France, where more quack preparations have appeared than any where else ; but since its composition has been guessed at, like most other medicines of the kind, its infallibility has in a great measure vanished. It consists, according to Dr. Swediauer, of nitrous mercury, precipitated by fixed vegetable alkali, and afterwards dissolved in vitriolic æther, when it is blended with some agreeable syrup ; so that, from its composition, it must possess very active powers, though we cannot speak of the practice of it from experience.

In the unguentum citrinum, the activity of the preparation is weakened by its union with an oily matter blunting its natural causticity. It forms a very powerful remedy in cases of venereal eruptions, where the disease unexpectedly breaks out from some remains in the habit, discovering itself only at one particular spot ; as an eruption of the surfuraceous kind about the roots of the hair, &c. But it is seldom applied to common venereal ulcerations ; and even when used in these eruptive cases, it requires to be still farther weakened by the addition of more oily matter than what usually enters its composition.

Thus Dr. Cullen recommends it to be rubbed down with double its quantity of hog's lard.

## DCCCCXXI.

The next preparations, according to our arrangement, are those with the sulphuric acid.

The turpeth mineral was a medicine formerly of much repute; but, from its violent effects on the *primæ viæ*, it is now seldom used, except where it is meant to act as a mercurial emetic. Where it is employed, it should be in very small doses; and even then, its powers should be moderated by the addition of opium. It is pretended by some authors to be more effectual than any other preparation of mercury in obdurate venereal eruptions of the skin.

## DCCCCXXII.

The saline preparations hitherto enumerated are those formed by solution in the mineral acids. But practitioners, wishing to lessen the corrosive nature of these preparations, which they ascribed to the virulence of the acids forming them, instead of the mineral, attempted to form them by solution in acids of a weaker kind; by which their caustic effects might be weakened, and their success as mercurials still preserved. On this principle, a number of the preparations were composed; the principal of which, deserving attention, are, Keyser's pill, and the terra foliata of Dr. Prellavin.

## DCCCCXXIII.

The Keyser's pill is formed by the solution of mercury in the acetous acid; previous to which, to render its solution more complete, by freeing it of any extraneous matter, it undergoes repeated triturations, and is passed

through a watery fluid : and after having finished the several preparatory processes, it is formed with manna, or any other saccharine substance, into pills. Their introduction into France met at first with considerable opposition. An opportunity being given for their administration in the Bicetre by the surgeon of that institution, they were not attended with that success which the accounts of their inventor led practitioners to expect. To judge, however, in an unprejudiced manner of Keyser's pill, we may remark,

1. That it is a saline preparation ; consequently it must possess the same activity with any preparation of the mineral in that state.

2. It is carefully freed from any extraneous matter before its saline state is formed. And,

3. The acid with which it is combined is of a weaker nature than most others.

On these accounts it must be a medicine of considerable efficacy ; though the enumeration of its advantages over frictions, the common method employed in France, is by no means a just way of determining its real merit, as all the other internal preparations that do not act with too much violence possess the same advantages. It has seldom been used in this country, as the process of preparing it previous to its solution is too tedious.

#### DCCCCXXIV.

The terra foliata, so termed by Dr. Prellavin, the inventor, proceeds on the same principle with the former, being a combination of mercury with cream of tartar. The views of the author in forming this preparation were,

1. That it should possess the same advantages with the other preparations with the weaker acids, in being used with more safety than the strong saline compositions, and being at the same time sufficiently active to effect a cure. And,

2. That the body giving it the saline state should possess stronger powers of solubility than any other similar body of the same strength, and thus that more real mercury might enter into the composition of the preparation; the latter being on this account, according to common opinion, more successful in the cure.

For these reasons it deserves to be perhaps preferred to Keyser's pill; but the difficulty of forming such preparations has been one great reason that they have never come into general practice; and their merit, therefore, has commonly rested with the original inventors; to whom the strictest credit in their details of their success is not always due.

#### DCCCCXXV.

But before the solution of mercury with the weaker acids took place, which is of more modern discovery, practitioners, in order to diminish the powers of the saline preparations, endeavoured to separate the mercury from its combination, by which, part of its virulence acquired in solution might be lost; and thus the precipitates came to be formed. Their manner of doing this, however, did not always tend to lessen the activity of the preparation; hence, they found by experience, that the greater part of them were unfit for internal use.

#### DCCCCXXVI.

The first way they attempted it, was abstraction of the oxygen acquired from the acid, by calcination of the sa-

line body ; but what it lost in power by the dissipation of its acid, it gained here in a different way by the process of calcination.

The next method, therefore, was, without calcination, to attempt the removal of the acid by the addition of such bodies as possessed a more powerful attraction for it than the mercury, or alkalis. But in very few cases can the abstraction of acid, even by alkalis, where it is combined with mercury, be entirely accomplished ; and where any portion remains, the preparation still retains a great share of its activity.

To assist, then, the action of alkalis, which was found incomplete, recourse was next had to the assistance also of heat, consisting in the combination of the two former methods ; but by this second process, the mildness acquired by abstraction of acid was counteracted by the degree of calcination they received, so that they were experienced still very powerful.

From the want of success, therefore, to render them milder in this way, instead of the alkalis, a trial was now made of effecting the same end, by their combination with compound substances ; but the same exposure to heat being in the greater number of instances necessary to accomplish their union, the same effect was experienced to attend these compositions in their still retaining a very active state. Hence, the only method to render saline preparations milder, consists in the abstraction of the original acid as much as possible, without allowing any farther process to take place.

#### DCCCCXXVII.

From this view of the operation of mercury, it would



appear that the less oxydation the metal receives, the more certain are its anti-venereal powers; a circumstance which militates strongly against the principle of the acids formerly detailed, and the other new remedies in this disease; nay, from some facts we might be led to infer, that were the mercury reduced to a simple earth, and could it be completely deprived of oxygen it would be still more permanently successful in producing a cure. To this conclusion we are irresistibly brought, if the facts adduced be just:

1. That the saline remedies which possess the highest oxydation, when trusted to alone, in the greater number of cases fail in effecting a permanent removal of the disease.

2. That the simply calcined or oxydated forms are more successful than the former; but.

3. That the triturated ones, in which the oxydation is least by the universal consent of practitioners, ever since their introduction, have been more confided in than any other, and that the blue pill and ointment are, as a proof of it, more in use than any other preparations of the present day.

The saline remedies, therefore, like the acids, may be employed to suspend quickly the violence of the symptoms at first, or they may be used simply to keep up the mercurial disposition in the habit for some time after the cure, as a matter of precaution.

#### DCCCCXVIII.

The next metal that has equally employed the attention of chemists for the purposes of medicine as mercury, is antimony; and where mercury has been appropriated in a particular manner to the removal of certain forms of chronic disease, antimony has gained its chief reputation by attacking

those of an acute nature, and particularly of the febrile kind. From oxydation it derives the most active powers to such a degree indeed, as to require to be moderated by subtracting part of its oxygen, and exhibiting it in divided doses in the most cautious manner. No medicine seems to possess such extensive and uniform powers over the discharge by the skin, and its exhibition is also sure to remove that constriction of surface so generally present in febrile diseases, with the resolution of which we find a crisis so often attended.

The use of antineurals in dysentery is a practice founded on the same principle as their operation in fevers, and as this disease is always distinguished by the state of surface conspicuous in fevers, and other marks of a morbid determination to the bowels, the restoring it to its proper channel is necessary to the cure. Hence antimonials in the acute dysentery and mercury in the more chronic is a proper distinction in practice. But the introduction of mercury in acute diseases is now a practice which is superseding every other, and from its permanent stimulus it has been found preferable to the more active but less certain operation of antimony. Hence its application in warm climates in typhus, in cynanche-malga, and in a number of affections to which it was formerly reckoned hostile in its nature, in which diseases, till the mercury has fully entered the system, no remission of the symptoms occurs; but from this period, a proof of the mode of its action, a decline of the malady takes place. \*

## DCCCCXXIX.

The chief preparations of antimony in use are the James's powder, or tartarised antimony and the emetic

swine. The former of these has been generally used in all cases of incipient disease, attended with febrile symptoms, in full doses, and afterwards continued in nauseating quantity, so as to produce a remission, chiefly by relaxation of the surface. The latter is more used in the complaints of children than in the cases of adults. No mineral affords a remedy of so uncertain operation as the antimony, from its strong attraction for acids; its oxydation is powerfully increased in the stomach wherever a disengaged acid occurs, either as the effect of disease or from the particular state of the contents of the stomach at the time. To render it a safe medicine, therefore, the great object has been to reduce it to an imperfect oxydation, and of all the forms for doing this that of the James's powder has gained the preference. It is from this circumstance, in order to render its operation milder, that some attempts have been made to introduce it, like mercury, from the external surface. This is done by frictions, either with a solution of tartarised antimony, or with it formed into an ointment, in the proportion of a scruple at a time. From the manner of its introduction, and meeting no disengaged acid in its course, as in the *primæ viæ*, its operation never, we are told, arises to any alarming height, and the secretions are gradually increased by it. Perhaps in this form it may be best suited to the cure of chronic diseases.

The sulphur antimoniacum precipitatum, and some of the other preparations, are chiefly employed in combination with mercury in chronic diseases of the skin.

#### DCCCCXXX.

The next metal introduced into medicine is zinc. An attempt has been made to employ its oxyd as a remedy

in convulsive diseases. From its astringent tonic nature; where these diseases are the effect of simple debility and relaxation, without any permanent local cause, it may be successful, and accordingly well attested instances of cure are on record; but its powers extend no farther. Of late it has been tried to combine this mineral with mercury, under the title of the *calx zinci hydrargyrata*, by adding to three parts of the triturated mercury by turpentine two parts of oxyd of zinc, by precipitating white vitriol by kali, and this combination is considered as wonderfully powerful in the cure of lues, and as acting by a powerful and tonic operation, without much increasing any of the secretions. The white vitriol is chiefly used as an external application, especially in eye-washes, and as an injection in gonorrhœa. Where internally employed it is as a vomit, where the operation of an emetic is required quickly, as in cases of poison. The oxyd, however, in the form of ointment, forms an useful application to gleetly sores.

## DCCCCXXI.

Lead is a metal of more general application than the last, but its use is almost exclusively confined to external forms. In cases of hæmorrhage, and in some cases of phthisis, the *cerussa acetata* has been cautiously employed in very circumscribed doses, and an alleviation of symptoms has sometimes attended its exhibition. But while it is thus dangerous and uncertain, as an internal remedy, it possesses much success as an external application. Whole volumes have been written in its praise, and the enthusiasm of Goulard carried it almost the length of an universal remedy. That it proves highly cooling and

sedative, in cases of local inflammation, there is no doubt, and especially where there is much irritation and pain. From its astringency it is successful also in such ulcerations as are the effect of simple relaxation, and in gleet; discharges its powers are useful wherever it can be safely employed. This, however, is the extent of its virtues. The more highly oxydated the more serviceable it is found, and hence its solution is commonly made in the acetic acid previous to use, so as to increase its oxydation to the highest degree. On this account the cerussa acetata is its preparation most in repute, though the cerussa itself is occasionally employed.

From the deleterious nature of this metal most of those employed with it are subject to be morbidly affected, in a peculiar manner, as it either occasions spasmodic cholick or palsy. These complaints begin here with obstinate constipation or griping pains in the bowels, paralytic affection of the extremities, a fallow complexion, and great emaciation. The progress of such symptoms is gradual, and therefore the workmen generally continue so long that they are incurable before they have recourse to assistance. The same symptoms occur in a lesser degree from the use of cerussated wines, the detection of which we have considered elsewhere. Oils and sulphur, properly employed, prove the only cure.

#### DCCCCXXXII.

Tin, the next metal, is of small importance in medicine. It has been employed in powder, as a vermifuge, with the view of acting by its gritty nature, in rubbing against the intestines, and thus removing the slime in which the worms are involved; but it is preferable for this disease when employed in the form of an amalgam.

## DCCCCXXXIII.

Iron is of all others the metal the most congenial to the human frame. It exists in it as a constituent principle, and the effects of morbidly augmenting it, which has been tried by the Italian physicians, is to increase not only the quantity of the colouring part of the blood, but also the general quantity of fibrine in the system. It is therefore a powerful and universal tonic, increasing by its oxydation both the colour of parts, and the general heat and animation of the body. The exact quantity of iron present in the system is difficult to determine, as authors are not agreed upon it. It is taken in greatest quantity from animal food, though it is liable to be changed somewhat by the effects of cookery previous to its introduction. Iron acts most powerfully when employed in the most imperfect state of oxydation; for of all the metals that enter the body, as medicine, it is the most liable to attract oxygen there. The situations of disease to which it is chiefly applicable are those in which an imperfect animalization is displayed, and where weakness proceeds from a defect in the constituent principles of the system, either in consequence of original conformation or accidental causes. This state is particularly characterized by a pallid countenance, by want of natural heat, and much disengaged acid affecting the *primæ viæ*. In such cases the use of iron is experienced most successful, particularly if joined with that proper quantity of nourishment which will afford animal gluten sufficient for the action of the medicine, or in order to its perfecting the process of animalization. In all cases of inflammatory disposition this medicine has been reckoned hurtful, and even in that

chronic inflammation which is combined with some obstruction of the viscera or small vessels it is equally so. Where ventured on here it should be in the form of a mineral water, as the saline combination will counteract any excess of its tonic power.

## DCCCCXXXIV.

Manganese has been considered as a species of iron, but by its medical effects it does not appear so. While iron is the most salutary to the human frame, this metal cannot be exhibited without much danger, by inducing the most active inflammatory state. It exists in small quantity in all animal bodies; but from some experience of its effects we venture decidedly on this opinion. Externally it may be safely employed, and it has accordingly been used with success in cutaneous diseases, particularly the itch, in the form of ointment.

## DCCCCXXXV.

Arsenic, of all the metals, is the most deleterious to animal life, and every day teems with instances of death from its imprudent application. As a medicine it has been long introduced, from its supposed tonic powers, and applied to the cure of obstinate intermittents, cancer, and some other species of ulcerations. In the first its use is perhaps less exceptionable than in the second, for here its application is generally for a very short period; but wherever the disease requires its long continuance, its pernicious consequences in undermining the constitution and sapping the general health, will greatly counteract any temporary advantages to be derived from it. Of the subject of cancer little can be said in its favour. That in certain ulcerations, resembling cancer, it has occasionally

succeeded, there is no doubt; but in real cancer, from much experience, we have ever found it do harm. In all cases it is exhibited in the form of an oxyd, and from its strong attraction for oxygen, it must be uncertain in its effects in different constitutions, when introduced into the system. No metal has its activity so much counteracted by sulphur as this. According to the quantity combined it can be reduced almost to an inert state, a proof of its strong connection with the saline nature. In ulcerations it has been applied chiefly externally as a caustic; and under the name of Plunket's powder, and some others, it has acquired considerable reputation, as it possesses the particular quality of acting without much pain, and induces on the part a speedy and effectual spacetus. One great secret to its success is the time it is allowed to lie, that a complete separation may ensue.

DCCCCXXXVI.

An attempt has also been made to combine this metal with others. In a communication to my much respected friend Dr. Garthshore, by Dr. Clarke of Dominica, the success of two combinations, the one with antimony, the other with mercury, are strongly instanced. The arseniate of antimony is prepared with the acid of arsenic, and the crocus or vitrum of antimony, in the same manner, and nearly in the same proportions, as the antim. tartariz. or tart. emetic, only with a larger proportion of the acid. arsenici filtered, chrysalized and pulverized; and the dose he used is  $\frac{1}{2}$  of a grain, in the form of a pill, twice a day; and after using it some time, he ventured to give  $\frac{1}{4}$  of a grain, in the same manner. This is the most useful of his two new remedies, the sensible



effect of which is by sweat, and its effects are very evident and extraordinary on the leprosy of that country, viz. elephantiasis or lepra grecorum ; and it may do good in the scaly leprosy.

## DCCCCXXXVII.

The arseniate of mercury, or hydrargyrus arsenicatus, although not so useful as the former, is more difficult of preparation. To a saturated solution of the nitrate of mercury add a saturated solution of arsenic. tartariz. or oxyd of arsenic saturated with fixed alkali salt, by degrees, till the effervescence ceases, by which means a double elective attraction will take place, by the acid of nitre laying hold of the fixed alkali, and leaving the mercury to unite to the arsenic ; or it may be prepared in the following manner, viz. Precipitate the mercury from the hydragyr. nitrat. by the addition of fixed alkali, and to the precipitate so obtained add the acid of arsenic, and boil it until a solution takes place ; which, on cooling, will chrySTALLIZE, in the same manner as it does in the hydrargyr. acetatus, of which Keyser's pills were supposed to be composed. Of this reduced into fine powder he began by giving  $\frac{1}{16}$  only of a grain, and afterwards  $\frac{1}{8}$ , for its operation is more powerful, sometimes griping and purging, if given in larger doses ; its chief effect is however by sweat, when given in very small doses. With it he has cured several negroes of the yaws, but more especially of the return yaws, so common in the West Indies, from bad treatment at first, and so difficult of cure, as is known to every medical practitioner in these islands. He knows not for what disease this preparation might be used

in a cold climate, perhaps in slight cancerous cases, or as an antisypilitic. The other may be useful in cutaneous diseases, especially such scaly scorbutic complaints as are commonly denominated leprous.

## DCCCCXXXVIII.

Copper is a metal which is more dangerous as a poison than useful as a medicine. It has been introduced, however, as a tonic in nervous diseases, under the form of the caprum ammoniacum, and in this form it has often been experienced highly successful where such affections do not depend on any local cause. Externally used it forms a powerful application in certain cases of ulceration. From its use as a kitchen utensil, accidents often arise by the oxydation of the metal giving a taint to the alimentary substance they contain. This generally happens in consequence of the tin covering or layer being worn off such vessel, and the alimentary substances being allowed to stand in them; for the oxydation of this metal takes place more readily in a low than increased temperature, and cold liquors therefore have a more powerful effect. The consequence of this impregnation is to produce violent sickness and vomiting, and when proceeding farther, general pains through the body and affection of the eyes. In such cases dilution at first, and oils and sulphur afterwards, will counteract the effects of the poison. The same consequences have been known at times to follow the use of vinegar, from an impregnation of this metal,

## DCCCCXXXIX.

Of the newly discovered metals none of them have been at all applied to the purposes of medicine, and of

the nobler metals, silver and gold, the *argentum nitratum* of the former is the only preparation in use. It forms the most useful caustic in surgical practice, and is externally applied for this purpose in most cases. Of late it has been introduced as a medicine internally, in cases of epilepsy, and other nervous affections, with the same view as the oxyd of zinc, and it is said with more decided success.

### \*DCCCCXL.

From this view it appears that the metals afford a number of powerful remedies, but in the exhibition of them their form should be regulated by the nature of the disease. Where metals are employed as medicines to subdue particular symptoms, and their action is quickly required, their oxydation and solution in acids is certainly their most powerful form. By this form they combine the powers of the remedies of the former class, or the salts, along with the peculiar property they acquire from the metallic base. By the new experimentalists this last circumstance has been lost sight of, and their action alone attributed to the saline form. In all chronic diseases, however, or where a continued and permanent action is necessary of a metal as a medicine; the more imperfect its oxydation the more successful will its operation be found, and hence, as formerly instanced, the superiority of the triturated preparations of mercury over every other, from that metal being in its least oxydated state. The precipitates we should consider as the most certain forms for medicines, could they be entirely freed from their oxygen.

## DCCCCXLI.

*Animal and Vegetable Substances.*

To finish our account of the objects of chemistry, it remains to examine the nature of the vegetable and animal substances.

All animal and vegetable substances are of a compound nature, and by this composition they are distinguished from the different bodies hitherto examined. The principles in all of them are the same; their union and modification are only found different; they cannot be imitated by art, as they are peculiarly combined in the vessels of the organic being, and are under the influence of the principle of life.

Their combinations, however, are so nicely balanced as to render them liable, on the slightest causes, to decomposition and change. This is effected either by the chemical powers, as heat, mixture, &c. or by the spontaneous action of their own principles on each other. This decomposition taking place, occasions new combinations of their principles to be formed; and these new combinations, from the similarity of their principles, are in all these substances the same.

## DCCCCXLII.

The ultimate principles of vegetable bodies, are carbon, oxygen, and hydrogen. The ultimate principles of animals are the same, with the addition of azote and phosphorus. A proportion of saline earthy and metallic matter is also found, but it is both inconsiderable and not constant. Lime and iron are the most constantly present of what we may term the extraneous elements.

## DCCCCXLIII.

Animal substances differ chiefly from the vegetable in their stronger tendency to the process of putrefaction; and this tendency is the consequence of their greater proportion of azote, phosphorus, and sulphur; the combinations of which yield largely of ammonia. Thus vegetable and animal substances may be considered as produced by a loose and slight collection of the principles

which constitute other bodies. Their production and growth are more rapid, and they have a constant tendency to as quick a dissolution of their constituent parts.

## DCCCCXLIV.

*Vegetable Substances.*

The vegetables come to be first considered, as having an intermediate nature between the animal and the dead part of the creation; for the vegetables are produced from the dead inorganic substances, while animals again proceed from them, either immediately or through the intervention of other animals.

## DCCCCXLV.

In entering upon this subject, we would indulge a little upon the immense variety of vegetables with which the scene of nature is beautified: some heighten it by their height, stateliness, and form; others by their order, elegance, and symmetry, diversified by their different species, and still more by their beautiful form, the colour in their flowers, and the fragrance of their smell; but besides their beauty, many of them hold a much superior rank, furnishing food as well as the necessary shelter for the different animals; and many are valuable, as being possessed of medical qualities, or for being otherwise useful in arts. For one or other of these purposes different kinds are adapted to different climates: the blackest hills nourish plants which will not grow to perfection in warmer situations; and by attending to this, botanists have reared in their gardens many plants which could not be brought to perfection before; we need not mention the immense provision made under water for the food and shelter of animals confined to that climate.

## DCCCCXLVI.

Without entering into the structure and economy of vegetables, the detail of which belongs to another place, the variety of substances which are distinguishable, in them we find referable to nineteen different kinds.

## DCCCCXLVII.

1. With regard to the solid fibres, or wood, it is little an object of chemistry ; it may be compared to the bones in the skeleton of animals. It remains after all the other substances are extracted by the different processes to which the vegetable is subjected, free of taste or smell, and insoluble in water, but still retaining a quantity of carbon ; its principles are more strongly combined than those of the other substances which the vegetable contains, and cannot be separated but by fire or putrefaction, to which it is much less subject than most of the other parts. Sometimes we meet with this part separated completely, after a long and frequent decoction of the vegetables ; at length, we have a matter still retaining the form, but quite destitute of any sort of juice, free of taste, odour, or any other sensible quality.

## DCCCCXLVIII.

2. The second principle is the mucilage, or gum. This matter, when it appears in the greatest perfection, is insipid, inodorous, soluble in water into a viscous fluid, not soluble in alcohol or oil, not volatile in the heat of boiling water, or fusible, nor more inflammable than the vegetable substances in general are.

## DCCCCXLIX.

This substance abounds so much in some vegetables, that the vessels burst and shed this juice. In this manner the gum arabic is obtained, and the gum tragacanth, and all the other pure gums, which are employed in pharmacy and in arts. We can see it break out from the bark of our common plumb and cherry trees ; we see a viscid transparent juice liquid like water, but which concretes into a solid transparent substance upon being exposed to the air.

## DCCCCLV.

This substance, though not acted upon by oils, shews a remarkable disposition to unite with them, when in the state of a mucilage, when combined with water in a viscid fluid ; and it not only unites with them, but renders them miscible with water ; but unless a considerable proportion of them be used we have not a perfect solution of the oily

matter, and it is liable to separate and rise again to the top, but the gum is notwithstanding dissolved, and combined to a certain degree with the water; and if the quantity of gum is sufficient, the union is so complete, that it will hardly separate at any rate; so that this sort of combination may be considered as a particular species of solution, and has been properly called emulsion, from the resemblance the mixture has to milk; the minute parts of the oil, which are not perfectly dissolved, reflecting the light, so as to give the appearance of milk.

This sort of combination is very frequent in plants, all these giving milky juices containing a substance of this nature; such juice being a combination of oil and resinous matters with water, by the intervention of gum. These juices, on being allowed to evaporate, concrete into a dark coloured substance, which is properly called a gum resin, containing a gummy matter, and resinous or oily matter united together at the same time. There are many of such compounds employed in pharmacy, as opium, assafoetida, myrrh, ammoniacum, sagapenum, galbanum, &c. and the greatest number of the resinous substances have it more or less united with them, as more or less of them can always be dissolved in water. This power of gum in promoting the solution of oily and resinous matter in water is particularly worthy of attention, because it is useful in pharmacy.

There are many plants the medical parts of which are resinous or oily; perhaps this is the case with the whole, or by far the greatest part of the vegetables remarkable for their medical power; it resides in some substance of an oily and resinous nature; now it happens, that these substances, as extracted from their respective plants, prove difficultly soluble in the stomach, so it is necessary to add some other substance which will promote their combination with water, and we cannot have recourse to any thing better than gum; for a gummy matter is free from this inconvenience: a slight acidity in the stomach has no other effect upon it than pure water; so it is the most proper

substance to be added to resinous bodies, to promote their solubility in the animal humours.

## DCCCCLI.

Gum is oxydated by different acids. Thenitric acids converts its into oxalic, and the oxygenated muriatic acid into nitric; but it cannot be converted into sugar, or made to pass into the vinous fermentation: its watery solution becomes clear, and forms the pyromucous acid.

By the analysis of gum its constituent principles appear to be oxygen, hydrogen, carbon, azote, and lime; and from the two latter its chief production arises.

3. The third kind of matter we mentioned is the aromatic oils and resins.

The nature of these we treated of when we were considering the variety of inflammable substances; and observed, that they were found chiefly in vegetables: any examples of them found in animals are very rare.

## DCCCCCLII.

4. The zecula, or starch, is a particular principle, which is most abundant in the nutritive grains and roots. It is extracted by beating or kneading them in water, and when properly prepared, is in the form of a light white powder, insipid, inodorous, and soft to the touch. It forms a gelatinous solution in hot water, but is insoluble in cold, and the same takes place when in the state of jelly; this circumstance distinguishes it from gum. It is also insoluble in alcohol.

Fecula is dissolved and oxydated by several acids; by nitric it is converted into malic and oxalic acids. Fecula is also convertible by a peculiar process into a saccharine matter.

## DCCCCCLIII.

This process is rather an operation of nature: it is an effect of the vegetative power; but art is employed in modifying the process, as in mashing. There are different kinds of grain, which may be subjected to this; but that



commonly employed is barley. The operation is to bring on a certain degree of vegetation; it is first steeped in water, and after a proper quantity of humidity has been employed, it is put up in heaps, when a slight degree of heat is produced, by a slight degree of fermentation, and with this heat and humidity it begins to vegetate or germinate, as appears from the shooting of the two principal parts of the vegetable from the centre of the seed, the plume or rudiment of the upper part, and the radical or rudiment of the under part. In proportion as these advance oxygen is absorbed and carbonic acid discharged; thus the change is produced gradually, from a farinaceous to a saccharine substance; and after the vegetation has proceeded a certain length, the grain is remarkably sweet, and has all the qualities of sugar: it is more soluble in water, dissolves into a viscid fluid like sugar and water. As soon as the whole has undergone this change, the process of vegetation is stopt, by scattering it and applying a drying heat; so the grain is now changed into a saccharine substance, which is soluble to a great degree in cold water, and dissolves easily with the assistance of a gentle heat. To this change all the purer farinaceous substances are subject, and even the roots of different vegetables, as potatoes.

## DCCCCLIV.

Several vegetables are remarkable for their *fecula*. The 1st is potatoes, the *feculum* of which is easily procured by grating them down, or dissolving by pouring on them a sufficient quantity of water, in which the *feculum* is first suspended, and then falls to the bottom. The 2d is briony from which, when rasped, the *feculum* is squeezed out by a press. The 3d is the *feculum* of the cassava, which undergoes a particular preparation. The 4th is *fago*, or the *feculum* of the pith of the palm, and the last is the *feculum* of wheat.

## DCCCCLVI.

The 5th principle of vegetables is their sugar, which is very remarkable in several respects, and the nature of it

is curious to a chemist. It has a pure sweet taste without any flavour; like other salts, it dissolves freely in water, and is capable of crystallization, and it refuses to dissolve in spirit of wine when strong, unless with the assistance of heat, and separates again when the spirit is allowed to cool; but in some of the other salts it has the power of resisting fermentation and putrefaction in vegetable substances, and this it possesses to a considerable degree; it contains a quantity of carbonic acid, as appears from the effect of burning it with an impyreumatic oil and carbonated hydrogen. Thus its principles are hydrogen, carbon, and oxygen: and these are in the proportion of eight parts of the first, 28 of the second, and 64 of the third; and it proves useful in the composition of mortar; added to lime it forms a hard mortar, and makes it more durable, probably by furnishing carbonic acid, which restores the lime to a hard calcarious stone.

## DCCCCLVII.

When sugar is oxydated it is converted into oxalic acid, and this is easily effected by distilling from it six parts of nitric acid. It has also been supposed that sugar was possessed of a saponaceous quality, for promoting the union of lime and water, like gum. Dr. Boerhaave considered this as one of the most useful qualities of sugar, with respect to medicines and pharmacy; but experience does not confirm this notion. It shows some disposition to promote the mixture of essential oils with water, but they have a considerable disposition to unite of themselves; and fixed oils also, when attenuated by repeated distillations, become so disposed; but when we try the fixed oils, we do not find that sugar assists their union with water.

## DCCCCLVIII.

Sugar dissolved in water, and placed in a certain temperature, undergoes a change in its composition, and is converted by the process of fermentation into ardent spirit.

## DCCCCLIX.

The successive formation of the three vegetable prin-

ciples we have hitherto described, is easier traced than any others. The sap containing the general principles of vegetable matter with some salts, having lime for their base, is changed into gum, which to the general constituent parts, possesses also, in addition, a proportion of lime and azote. By the attraction of the two latter principles *secula* comes next to be formed; and by the addition of oxygen to this part, and the extraction of the proportion of its carbonic acid, it is converted into sugar. Thus sugar possesses an excess of oxygen, and its production is favoured by a seclusion of the vegetable parts, that contain it from the light.

## DCCCCLX.

6. The next principles of vegetables are gluten and albumen. The first is contained in most farinaceous grains and roots, along with the *secula* and sugar. It is insipid, of a grey colour, is very ductile and elastic, and resembles the gluten of the animal. It exists in the best flour in the proportion of from one-fifth to a third part. It is insoluble in water, and only so in small quantity in alcohol. It is dissolved by different acids, and these solutions are again decomposed by the alkalies. The nitric acid, in dissolving it, extricates a considerable quantity of azote, and its residue forms oxalic acid. By heat it is subject to putrefaction, and when decomposed gives out, as its chief product, much ammonia. Hence it appears a composition of azote with hydrogen and carbon.

## DCCCCLXI.

7. Albumen, the other principle, is combined with the former. It is dissolved by the water, by which the flour is decomposed, and separates, when it is heated, in light flakes. It is soluble in cold water, but coagulates by heat or alcohol. It dissolves in the alkalies, is liable to putrefaction; and when decomposed by heat, affords ammonia.

## DCCCCLXII.

The mixture of *secula* and sugar with these two last principles in vegetables, gives a just superiority in point

of nourishment to those substances that contain them, being already, as it were, somewhat of an animal nature.

DCCCCLXIII.

8. Oils, the next principle of vegetables, was already examined in the class of inflammables, both those of an essential and fixed nature, and their general properties of unctuousity and inflammability considered. Camphor, another product, was also classed under the same head, being an essential oil, with a larger proportion of carbon.

DCCCCLXIV.

9. Wax came under the same distinction, being a variety of the fixed, in the same manner as camphor is of the essential, oils.

DCCCCLXV.

10. Resins and balsams were treated under the same division, the former being merely an oil rendered concrete by oxygen; the latter, being a resin, with the benzoic acid. A variety of the first often occurs, termed gum resin, in which an intimate union of the gum and resin takes place.

DCCCCLXVI.

11. Extract, the next vegetable product, has not hitherto been treated under any of the former divisions. It is a dry brown matter, slightly deliquescent in the air, and soluble in water. It is obtained from the juices of the plants by mechanical pressure, from the plant itself, by infusion or decoction, and the subjecting it to inspissation. It is equally soluble in water and in alcohol, and it absorbs oxygen, when exposed to the atmosphere, thus lessening its solubility. By oxygenated muriatic acid it is converted into a concrete substance of a yellow colour, insoluble in water, and by distillation it affords an empyreumatic oil and acid, with ammonia. Its constituent principles are those of every vegetable along with azote.

DCCCCLXVII.

12. A peculiar vegetable product falls next to be examined, termed the caoutchouc, or elastic gum. It is the inspissated juice of a tree in South America. It is

obtained by incisions in the bark ; it is at first thick and milky, and becomes concrete on exposure to the air, from the absorption of oxygen. It is remarkable for its ductility and elasticity, when dry. It is softened by water, is dissolved by the ethers, and by the fixed and essential oils. It is not acted on by the alkalies, but is altered by the sulphuric and nitric acids. It is softened and loses its elasticity by heat. Its elements are the general constituent principles of vegetables with azote.

## DCCCCLXVIII.

13. The vegetable principles that come next in succession are the various species of acids already detailed under the head of salts. These acids we found peculiar to certain plants, and also to certain periods of their vegetation. They have all the other vegetable products, a base of carbon and hydrogen, and differ from each other chiefly in the proportion of these principles, and hence their conversion into each other. The oxalic being the one most highly oxygenated, into it the others are changed.

## DCCCCLXIX.

14. Alkalies, as well as acids, are also, as we have formerly seen, a vegetable product, and these alkalies are confined to potash and soda. The first is found in all plants that grow at a distance from the sea ; the second is found in all the plants that grow in the sea, and in many that grow on land.

## DCCCCLXX.

15. Tannin, or the tanning principle, is another peculiar vegetable product. It was formerly considered with the vegetable acids.

## DCCCCLXXI.

16. Earth is also present, in a certain proportion, in all vegetables ; and the kinds met with are lime, silica, magnesia, and alumine. The two first, however, are the most abundant, particularly lime.

## DCCCCLXXII.

17. Metals are occasionally met in vegetable substances.

The principal one is iron, which exists in most plants Manganese and gold have been also detected.

## DCCCCLXXIII.

18. The aroma of vegetables has been marked as another distinct principle for the examination of chemistry. Though residing generally in the essential oil, it is by no means exclusively confined to it, but exists as a separate principle, more subtle and volatile than essential oil, and on which the odour of the latter depends. Hence it is found in plants in which no essential oil exists, and it is easily imparted to water by these plants, being readily disengaged from any plant by a moderate heat.

## DCCCCLXXIV.

19. To these principles of vegetables may be, lastly, added the colouring matters. In different vegetables this matter has different chemical properties. It is extracted by different solvents; and in its production or application to substances, it is certain oxygen acts an important part.

## DCCCCLXXV.

After this view of the principles of vegetation we are next led to the combinations they form in consequence of their decomposition by fermentation.

## DCCCCLXXVI.

*Fermentation and Putrefaction.*

The saccharine farinaceous parts of vegetables are more disposed to undergo a great change by what is called fermentation; the other parts have a disposition to other changes, which are called putrefaction, corruption, or dissolution. It is proper, therefore, to consider these changes. The disposition is in consequence of the loose cohesion of their constituent parts.

## DCCCCLXXVII.

*Vinous Fermentation.*

The saccharine matter only, and the farinaceous, when converted into saccharine by vegetation, can undergo this fermentation; but they must be dissolved in

water, and reduced to fluidity, either naturally or artificially. All the juices of fruits contain a saccharine substance dissolved, and they are remarkably prone to this fermentation; but if the matter is not already fluid, as honey, malt, dried fruits, sugar, farina, it must be dissolved in water; and as fluidity is necessary, so the degree of fluidity influences the readiness and perfection with which this change is performed. If too little water is added there is always a quantity of vegetable matter remaining unchanged. If we dilute more largely, the fermentation is more quick and rapid, and has a greater tendency to run into the acetous.

#### DCCCCLXXVIII.

Another circumstance which influences the quickness and perfection of this change is the temperature of heat. A certain degree of heat is as necessary as the dilution in water; a moderate temperature answers the best. If the heat is too great it is apt to pass from the first into the second stage; if too little, it stops it. The phenomena which attend and succeed one another are these; it is easy to observe them by making the experiment upon a moderate quantity of saccharine matter, fermented in water, and done in a glass vessel. There is first an absorption of oxygen, and the separation of an elastic aerial matter, or carbonic acid, from all parts of the fluid, which uniting into minute globules, arises from all parts towards the surface, producing a motion in all the parts, and a sensible hissing noise, and it soon forms a scum or froth, which retains for a while the little globules of air. The separation of it produces a remarkable change in the density or weight of the fermenting liquor; the vegetable fluid, when fermenting, must suffer some loss of evaporation, which should concentrate the solid matter, and render it a heavier fluid; but instead of being denser it is lighter. Upon being put into the same vessel with water, it will swim upon the surface of the water, whereas before fermentation it is heavier, containing a quantity of saccharine matter, which has a density greatly superior to that of pure water.

At the same time that carbonic acid arises from the fluids, there is a separation of some solid substance, which appears floating throughout the liquor, and renders it muddy; and this matter separating, a part gradually settles, and forms the sediment called lees, and a part buoyed up to the surface by the air, gives a firmness and solidity to the scum formed by the air.

At the same time that this goes on there is a gentle degree of heat; the fluid is a little warmer than the surrounding air.

### DCCCCLXXIX.

After these phenomena have continued for a few days, according to the degree of heat, all the effects of the fermentation begin to abate; the heat of the liquor diminishes; the agitation of the fluid, in consequence of the separation of the carbonic acid, is less considerable, the liquor clears, and the scum falls to the bottom, unless there is something to support it. The muddiness at first was chiefly occasioned by the constant rising of the carbonic acid driving up the feculent particles, which are separated by the fermentation; and as soon as the separation of the carbonic acid ceases, these particles gradually settle, and the remaining carbon and hydrogen combines. This is the case especially in the fermenting of beer. In the management of wine, a particular art is necessary to prevent the scum from falling; they throw into the vessel, which is large, the stalks and husks of the grapes, which remain after the juice is squeezed out. These swim upon the surface, and entangle a great quantity of the feculent matter, as it separates, so as to form a thick and firm covering to the fermented liquor, which prevents too great absorption of oxygen and consequent dissipation of the carbonic acid, by preserving its surface from the contact of the air: so the wine turns out the stronger, and a great quantity of that feculent matter thus entangled is kept there, and prevented from settling at the bottom, so that the greatest quantity of the liquor can be drawn off clear below. When we now examine the liquor we



find a remarkable change; the odour and taste is different. Before it was sweet, with little odour; it had a certain sweetness and flatness: but after the fermentation has proceeded so far, it has a very agreeable odour, and the taste is very grateful to the palate, but pungent; it is possessed, besides, of an inebriating quality which it was free from before; and we find that it now affords by distillation a spirit of wine, a sourish, seculent, watery liquor remaining behind; whereas before the first vapours are purely watery, a thick syrupy matter remaining, which contains the sugar dissolved in water. The fermentation, carried on so far, is called the vinous fermentation, or first stage, and the liquor so produced is called wine, or vinous liquor, being a new combination of the remaining carbon and hydrogen of the sugar; and if it is preserved moderately cool in a glass vessel, it will continue for a long time, but still with a slow progress towards the next state to which it has a tendency. It deposits a small quantity of the seculent matter, which it deposited so plentifully during the fermentation, and a quantity of tartar. In consequence of this the wine improves in its quality, and is found to be much more perfect than it was at the first; but after this time it begins to decay, and to lose its perfection, which shows that there is a constant and gradual progress towards the next stage, and which is necessary to the perfection of wine, and other fermenting liquors.

We must not consider the wine as in a quiescent state; there is still a fermentation going on, though in a slow and imperceptible manner; and it is probable that the perfection of the liquor depends upon the progress of this fermentation; for if it is checked too much the liquor becomes vapid, as when it is affected by thunder. Again, if it is kept too warm, the slow fermentation goes on rather too fast, and it makes too fast a progress towards the acetous fermentation.

What then are the circumstances which occasion the sudden check to the violent fermentation? why it should

stop as soon as it comes to the state of wine, without proceeding immediately to the acetous fermentation? It is clear, by the new combination of the principles, or the quantity of ardent spirit produced in it; this added to the vegetable juice, the most disposed to fermentation, will effectually prevent its undergoing this change; or added in small quantity to a vegetable liquor that has too much disposition this way, it will check it in a certain degree, so as to render the fermentation more regular; as soon then as it comes to abound in the liquor it proves an obstacle to the further progress; and vegetable fluids, which are too rich will never ferment so perfectly, and therefore all strong wines are attended with a certain degree of sweetness, a great quantity of the matter not being fermented; for as soon as a quantity is changed into ardent spirit, that proves an obstacle to the fermentation of the rest of the saccharine matter; therefore to have a liquor fermented to the most perfect degree, it must be diluted to a certain degree. And further, the other circumstances most necessary to a perfect fermentation are, a moderate temperature of heat, and a great attention to the cleanliness of the vessels; the slightest taint or odour residing in the vessels is communicated to the liquor, and diffused through a great quantity of it during the process.

### DCCCCLXXX.

#### *Acetous Fermentation.*

If the liquor which has undergone the vinous fermentation be kept in a temperature of 75 to 80 of F. it proceeds to what is called the acetous change.

The change here is not remarkable; there is merely an absorption of oxygen, and no carbonic acid given out, so that the alcohol becomes oxygenated, a gross unfixed matter separates to the bottom, the liquor in consequence loses its vinous taste and flavour, it becomes sour, and on distillation affords no alcohol; it affords only a quantity of water; it is the acetous acid, formerly considered; and if this is distilled it may be kept in this state, when sepa-

rated from the unctuous matter which preserves it from the putrid change ; but kept with this unctuous matter it becomes dark coloured, loses its sour taste, and acquires an offensive one, and now it affords only an ammonia, and this is called the putrefactive fermentation.

#### DCCCCLXXXI.

Thus from the progress it appears that the same substance which is capable of the vinous, is also capable of the acetous and putrefactive fermentation, and we may say it has always a tendency that way, and that it is impossible to induce the first without a mixture of the second, or the second without a mixture of the third ; for every wine is a little acid, and therefore there are few vinegars without some slight disposition towards putrefaction, in which there is not a little volatile alkali produced, though it is neutralized by the acid, which predominates.

At the same time it is to be understood that the acid change is not confined to substances which have previously undergone the vinous or the putrefactive fermentation, or the latter to those which have undergone the acetous. All vegetable substances have, more or less, a tendency to the putrid, and a great number of them are capable of the acetous ; but the number of those which are capable of the vinous is not considerable, and those which are capable of the acetous will run into the putrid, in circumstances in which they cannot undergo the vinous ; the circumstances necessary to which do not readily occur, for they must be reduced to a state of perfect fluidity with water, and this does not readily happen unless it be done on purpose, at least that a large quantity is collected fit for undergoing this change in a proper state of fluidity. The acetous change does not require such a complete degree of dissolution. Such a quantity of water united with a vegetable substance as will merely give it softness, will render it capable of acceffency ; so flour made into a paste will become sour, but more water must be applied, and it must be dissolved perfectly to fit it for the vinous ; for the

putrid, again, more dampness is sufficient: so the most solid and durable parts of vegetables, as the wood is liable to a change of this kind; the progress is slow and gradual, but it is effectual in totally dissolving their texture. In some cases, where the subjects are a little more succulent, and so spongy that they preserve the heat produced by the putrefaction, this putrid change goes on with such a rapidity as to produce a great quantity of heat; and in this way hay-stacks, &c. put up too damp, suffer the putrid change so fast that a quantity of inflammable vapours is produced, which sometimes occasions them to take fire. When the vegetable substances which undergo the putrid change are naturally solid and firm, the effect of it at first is to render them tender and friable; and as the change proceeds, they are quite disunited, dissolved, and broken down into a powder, and during this change the vegetable substance suffers a great loss by evaporation, a great part of it being volatilized. What remains is a small quantity of an earthy substance, which is said to have some of the qualities of clay, forming a plastic mass, when mixed with a small quantity of water.

## DCCCLXXXII.

The vapours which exhale during this process have also a musty, or more disagreeable smell; the ammonia is discoverable when vegetable substances are putrified on purpose; for in the common manner the change goes on slowly, and if exposed to the air the volatile alkali may be dissipated, and so much diffused as to become insensible; but when the substances are amassed together, confined, and loaded by a considerable weight, the putrefaction goes on to a more perfect degree, and the ammonia can be obtained by distillation. The effects of these musty vapours are to render the combination of lead with the vegetable acids of a black colour. Silver too is tarnished by it; and where these vapours are produced in large quantity, as in a stack of hay, they show themselves in flame, setting the stack on fire. And on other occasions the escape discovers itself by an

emission of light: so rotten wood appears luminous in the dark.

### DCCCCLXXXIII.

It further remains to be observed, that all these changes are greatly promoted by the addition of ferments. A ferment is a substance of the same nature which has already undergone some degree of the change which is to be introduced upon a greater quantity of the same sort of matter. In this country we are most accustomed with the effect of these in the manufactory of vinous liquors, a quantity of the scum formed on the surface by the rising of the carbonic acid and mixture of the seculent parts of the matter; or a little of the liquor itself added to a fresh matter will make a beginning, and occasion the whole to run through the vinous fermentation in a regular manner. And it would be impossible, without matter already in a state of fermentation, to bring the farinaceous into the vinous fermentation. Without this it is disposed to run into the acetous when diluted with water; and even when it is malted, or changed into a saccharine substance. Ferments have been thought capable not only of enduring fermentation, but of inducing a change in the nature of the liquor which the fermentation produces; and it has been proposed as an improvement in the art, to take ferments from other liquors, from some of a higher or more delicate flavour; as from fermenting wine to be added to an infusion of malt, that it may dispose it to be changed into a liquor approaching more in taste and flavour to wine than if the fermentation was brought on by means of the ordinary ferment: but there are no facts in proof of this, otherwise than that an acetous ferment will determine a fermentible substance to run faster into the acetous state than one from the vinous, and in the same manner of the putrid; so those employed in the manufactory of vinegar from the infusion of malt, find it of consequence to preserve the vessels long used; the seasoning received from the constant use renders them much fitter for producing the change of fresh matter into good vinegar than any other vessels.

And with regard to the vinous fermentation in the infusion of the sugar cane, by which the vinous liquor is obtained that afterwards affords rum; it is of consequence to wash the vessels with a small quantity of liquor which has been fermented before, or of the rum which has been distilled, whereby the liquor affords a quantity of the spirit; so it seems plain that a vinous fermentation will dispose a substance, capable of the vinous, more readily to undergo that fermentation; and in some cases will bring it on where it would not have been disposed; whereas the acetous ferment gives a stronger disposition to run immediately into the acetous. And the same thing holds with regard to the putrid; but still the acetous ferment will not hinder a substance which is strongly disposed to the vinous fermentation from becoming in some degree vinous. In like manner the putrid ferment will often bring on the vinous and acetous fermentation, though with a stronger disposition to the putrid: so with regard to the alimentary mixtures, a small quantity of putrid matter is found to bring on a small degree of vinous fermentation, instead of the putrid. But it is not imagined that a ferment will change the nature of the fermentation, occasioning the substance to produce a different sort of vinous liquor from what it otherwise would have done. Perhaps what may have given rise to this opinion is this, that any flavour attending a ferment is wonderfully diffused through the liquor to which the ferment is added.

## DCCCCLXXXIV.

From this account of fermentation will be easily understood the effect of some circumstances which retard or prevent it. The most effectual way of preventing these changes in vegetable substances is to dissipate their watery parts, and preserve them dry. Accordingly, many vegetable substances which are very prone to these changes, are preserved by this method; so roots of various kinds are preserved in this way, and in this way, the botanists have learned to preserve their plants, by drying them quickly, even so as to retain their colour in a wonderful

degree of perfection. There are some other means which have a great effect, the nature of which is not so easily explained as spirit of wine, which gives a check to the vinous fermentation: common salt, sugar, nitre, acids, and other solid substances, especially the volatile sulphureous acid, which is used in the wine countries, have this effect. It is also proper on many occasions to exclude the air, or even to extract it by the air pump: heating the substances to the degree of boiling water, produces some change in the combination of their plants, which facilitates their preservation from this change.

## DCCCCLXXXV.

The electrical fluid, lightening, thunder, &c. totally check fermentation; and the common remedy is to put a lump of iron upon the cask; but it is more proper to fix a rod of iron at some distance, that the electrical fluid may run entirely off.

## DCCCCLXXXVI.

These different kinds of intestine motion, or fermentation, require attention, before we proceed to consider animal substances, as the change of the vegetable into the animal matter has been supposed to depend in some measure upon a disposition which the vegetable has to undergo some of these spontaneous changes or decompositions.

## DCCCCLXXXVII.

From this view the vegetable principles, as applied to medicine, become naturally divided into two kinds, dietetic and pharmaceutical. The former includes the fecula, sugar, albumen, gluten, and fixed oil; the latter comprehends all the others that admit application. The first we have detailed at length in a separate publication (*Vide Treatise on Diet*); the latter has been chiefly examined in the class of inflammables, (p. 121.)

## DCCCCLXXXVIII.

*Animal Substances.*

All animals are fed upon vegetables, either directly or through the intervention of other animals. No part of

the substances of animals is from any other source except water. The small quantity of salt used by man, and some other animals, seems to be necessary only as a seasoning, or as a stimulus, and not as affording any thing nutritious: so animal matter, when subjected to trials, is resolved into the same principles as the vegetable matter, with a large proportion of ammonia, and generally foetid gases, consisting of hydrogen, azote, sulphur, and phosphorus; the foetid residue consisting of iron and phosphoric salts.

But though the principles of animal and vegetable substances are at the bottom the same, they are combined in a different manner: the compound is very sensibly different. There is hardly any such a thing among animal substances as the vinous or acetous fermentation, they run remarkably fast to the putrid; we do observe some receiving the acedcent, as taken notice of in the acids; but it is rare.

#### DCCCCLXXXIX.

The difference in the principles of animal matters from those of vegetables lies chiefly in their containing azote, generally phosphorus, and not unfrequently sulphur. The azote and phosphorus give the tendency to decomposition which distinguish the animal over the vegetable body, and the effect of this decomposition is the production of ammonia, Prussic acid, and other matters.

Animal substances exceed also in their proportion of hydrogen, compared with vegetables. Hydrogen, therefore, forms their principal base, as carbon is of vegetables; and as animals live on vegetables, the changes producing these new principles are the effect of the action of their functions of digestion, respiration, and secretion.

The principles they derive from vegetables are clear. Azote, it is probable, is drawn from the atmosphere by the animal; phosphorus seems the product of animalization, drawn from the vegetable origin; and all their other principles are productions from the same source.



## DCCCCXC.

The putrefaction to which animal substances are remarkably prone, compared with vegetable matters, has made it an object to contrive means for preventing it. In general they are preserved by means similar to those used for the preservation of vegetable substances. In order to preserve a succulent animal substance from decay, for only a short time, the circumstances most necessary are coolness and dryness of the air which surrounds them, and especially the wiping off any small quantity of corrupted matter which collects on the part next in contact with the air, in which the corruption takes place first, for this proves a ferment, promoting the corruption of the neighbouring parts; so it is of consequence to separate these parts in which the change is begun: but this method will only serve for a short time.

## DCCCCXI.

Another method is by exsiccation, by dissipating their moisture, whereby they may be kept a long time in dry air: or if this is inconvenient or improper for the purpose in view, we employ antiseptics. Common salt, in large quantity, answers the purpose; nitre is still more powerful, but we cannot use it so freely; sugar too is very powerful, but it is seldom used, on account of its price.

## DCCCCXCII.

On studying this subject more particularly, it is found, by experiments, that all the salts have more or less of an antiseptic power, except common salt in small quantity, which rather promotes the corruption of animal substances; but the fixed volatile alkalies, which are considered as highly putrescent, are now acknowledged to be antiseptic, as are also bitters, astringents, and aromatics; and the bark is very remarkable for its power in preserving animal substances; the camphor is found to be very powerful, and therefore given in small doses in putrid diseases. But above all, the nitrous gas seems to be the most powerful, according to Priestly's experiments.

## DCCCCXCHII.

The list of septics, or those substances which promote putrefaction, is much shorter. Nothing is found to have the tendency but putrid ferment; a mass of putrid matter, already in a putrid state; the calcareous, and other absorbent earths; magnesia, particularly; and a small quantity of common salt.

## DCCCCXCIV.

From this general view of the animal matter we next consider the variety of it which is to be found in the bodies of animals, and this variety may be divided into *solids* and *fluids*.

## DCCCCXCV.

*Animal Solids.*

The solids do not differ greatly, except in the proportion of their earthy matter. In animal, as well as vegetable substances, earth seems to be the principle of solidity; the hardest parts are the bones and horny parts; next to these are the cartilages, next to these the tendons and ligaments, then the muscles; and in general they have more earth in their composition in proportion to their solidity. These parts also afford a large proportion of ammonia which arises mingled with a nauseous empyreumatic oil; so it is separated, in some measure, by repeated rectifications, but never completely. It always retains some degree of foetid odour, as in *sal cornu cervi*. The oil itself, subjected to repeated rectifications, turns out more subtile and volatile, and less offensive, and seems to be more efficacious in promoting sweat and calming convulsive motions; but the process is so tedious and disagreeable, that it is hardly to be met with.

## DCCCCXCVI.

Water being boiled with animal substances, extracts a considerable part of their substance, which thickens as the vegetable gums do: when the liquor is allowed to cool, forms a strong jelly; and when a considerable quantity of this is dissolved, it proves much more adhesive than the vegetable gums.

## DCCCCXCVII.

With regard to the other solvents on the animal solids there are none which have any remarkable effect but the corrosive salts, of the acid and alkaline kind, and quicklime. The acid attracts the earthy parts more strongly from the alkaline salts which many of them contain. We have an example of their acting upon the earthy parts, without affecting the other parts, in some elegant anatomical preparations, as of the teeth and of the jaw-bone, and other bones in the body : these are obtained by injecting the vessels, and afterwards steeping them some time in a diluted fossil acid, particularly the muriatic acid ; and after some time the whole of the earthy matter is dissolved, the glutinous part remaining and retaining the form, it becomes transparent like glass, so that the vessels can be seen passing through the internal parts. If the acids applied are stronger, the parts are completely dissolved ; they take up both the earthy matter and the gelatinous ; and in this way we have some elegant anatomical preparations. After any part of the body is injected with wax, it is steeped in the strongest spirit of salt, which totally dissolves all the animal matter, leaving nothing but the wax molded in the internal cavities of the vessels, in such fine filaments that it requires a microscope sometimes to see them. The muriatic acid answers best, as being a very powerful solvent of animal matter, and less liable to act upon the inflammable matter of the wax than the nitrous, or vitriolic, or the caustic alkalies.

## DCCCCXCVIII.

The bones are composed of cartilage, which consists almost entirely of gelatin, of phosphate of lime, carbonate of lime, and sulphate of lime. By boiling water under an increased pressure, as in the digester, the gelatin is dissolved. By maceration in an acid, the phosphate of lime becomes extracted, and the parenchyma of the bone is left. By decomposition by heat, ammonia, empyreumatic oil, and carbonated hydrogen, are produced.

## DCCCCXCIX.

The base of the muscular fibre is fibrine, a white, in-

lipid, inelastic matter, which heated with nitric acid gives out azotic gas, and is converted into malic and oxalic acid. The macerating water contains the colouring matter of the blood, gelatin, albumen, saline matter, and fat. The proportion of gelatin exceeds, in the young muscular fibre, the proportion of fibrine in that of age. Decomposed by heat the common products of animal matter appear along with a peculiar acid, formerly treated, the zoonic.

#### M.

Fat we already considered as of the same nature with the vegetable express oils. It is insipid, inodorous, insoluble in water, and in alcohol, and with alkalies combines so as to form soap. By the absorption of oxygen from the air it acquires acidity; and a peculiar acid, the sebacic, is formed. It is oxydated by the acids, particularly the nitric. When decomposed by heat it affords an acid liquor, an empyreumatic oil, and carbonated hydrogen. It oxydates several of the metals, when combined with it in the form of ointment.

#### MI.

The pulpy matter of the brain approaches nearly to albumen; and it is mixed with phosphate of lime, soda, and ammonia.

#### MII.

The other solid parts, viz. membrane, ligment, tendon, and cartilage, consist of gelatin rendered concrete by a slight degree of oxydation, and they differ from bone chiefly from the latter possessing a greater quantity of phosphate of lime in their composition. Of these parts the epidermis seems to possess the highest degree of oxydation.

#### MIII.

##### *Animal Fluids.*

With regard to the animal fluids, we can here find a distinction between a general fluid and others prepared from its secretion.

The blood is not only the same in different parts, but even in different animals. Examined as taken from

man, it appears a homogeneous fluid, a little heavier than water, so having a tendency to the bottom, but readily mixing with water of the same temperature; and further, it consists mostly of water.

To understand its nature more particularly, it is necessary to examine it, to attend to a number of parts which are easily separable without the application of a strong heat, and to examine their qualities.

#### MIV.

If blood is barely allowed to stand at rest for some time, we see these parts; though at first it appears a perfect fluid to the naked eye, it is not so in reality. The microscope discovers it to be, even in the natural state, a mixture, having a certain degree of fluidity, with a matter having a certain degree of solidity. It is formed into minute globules, each of which consists of a flatted particle and reddish, so as to produce a red when united. The coagulability of the blood is known, when exposed to the air, and its separation into serum and crassamentum. This was formerly imputed to the action of cold, but it has been found that it does not depend upon cold principally, but upon the influence of the contact of the air, for it has been found that it coagulated better when it was kept pretty warm.

#### MV.

The properties of the serum come first into review. It is a yellow, transparent, sub-viscid fluid; to the taste and smell it has no appearance of a separate acid or alkali, as has been supposed by some reasoners in medicine. It preserves its fluidity in the ordinary heat of the air, but contains a quantity of matter or albumen, which becomes solid in about  $160^{\circ}$  of Fahrenheit. The effect of this is to convert the whole of the serum into a jelly, which is produced by the fermentation of a number of minute threads or fibres which the coagulated part forms throughout the whole of the fluid that coagulates the remaining fluid, like the fibres of a sponge. That there is a quantity of water still appears fluid when we

take a quantity of it and suspend it in the air, the parts contract, and squeeze a quantity of water out of their pores. It would seem, therefore, that the coagulable part has a disposition to coagulate into a reticular texture, or spongy mass, and we can understand the use of this part of the blood; or if the albumen ovi in the clarification of sugar and common salt, as the heat increases to  $160^{\circ}$ , or a little more, according to the degree of dilution, it separates into fibres throughout the whole of the fluid, and forms a subtile net-work. As the heat increases, this fibrous matter is gradually thrown up to the surface, partly too by the separation of the air; and while it is compacted into a denser body, it entangles in its masses all the lighter floating impurities; so having collected these, it appears in the form of a dark impure scum, and the liquor below is a clear transparent liquor.

## MVI.

Besides this action of heat it is affected by several chemical liquors in the same manner, as by strong spirit of wine, mineral acids, and their combination with weak earths, as allum, or some of the metallic salts. The acetous acid is rather a diluent, and a preventer of the coagulation of the blood, in its ordinary diluted state; but when it is brought near in strength to the mineral acids, it produces a semi-coagulation, though not altogether so soon. The cruor, at the beginning, occupies the whole mass, so as to give the whole the appearance of a soft jelly; but contracting in all its dimensions, it comes to be surrounded with serum, preserving the form of the vessel. This mass is a little harder than the serum, so when thoroughly melted it sinks, but the upper surface being left dry, and contracting more than the under, forms into a concavity, and floats upon the surface, as any hollow body or boat does upon water.

## MVII.

A more particular examination of this mass shows that it is chiefly composed of red globules, few remaining in the serum; and its solid consistency has been attributed

to the attraction of these globules : but if they have any attraction for one another, it is very inconsiderable, and is not the cause of the firm concretion. The solidity evidently depends upon the existence of a third substance, the coagulable lymph, or animal gluten or zebrine. This matter is at first perfectly fluid, but it has the same tendency to coagulation as the serum, but in a much greater degree : so it coagulates in an inferior degree of heat, and tends to coagulation even by rest, especially if the air is admitted, which greatly promotes its coagulation. It seems however to be very much akin to the coagulable part of the serum, the parts are formed into minute filaments of a reticular texture that entangle the fluid parts of the blood in their pores ; this reticular texture is at first equally diffused, and gives the whole the consistence of a jelly. But afterwards the lymph slowly contracts, squeezing the serum out of its pores, but retaining the red globules, which it draws together, and brings them into closer contact with one another. Upon this part the coagulation of the cruor depends : so when we expose a mass of the cruor to a stream of water, it carries away all the red globules, and leaves a gelatinous mass on the surface of the blood, which appears to have been the cause of the solidity of the cruor ; and the red globules being so easily carried off, show that they did not contribute to its solidity.

## MVIII.

Another manner of discovering it is this, as soon as the blood is let, if it is stirred with a bundle of small sticks, it will prevent its coagulation, the blood remains fluid, and examining the sticks we find the coagulable lymph concentered into a membranous matter on their surface ; so we only prevent it from forming that subtil fibrous texture which is otherwise diffused through the whole mass, and force it to concrete on the surface of the sticks. In this way we have the coagulable matter perfectly colourless, while the red globules are mixed with the serum, and in a fluid state.

## MIX.

Another experiment to obtain this part is by receiving it into a phial from the vein, and corking the phial, then agitating it with the air, the air is applied to all the parts more equally, and produces the whole effect of coagulation; but not coagulating in a regular manner it does not entangle the red globules, so they continue by themselves, and the gluten is formed into fibres or membranous masses, resembling a bit of flesh, and we can see the coagulation by receiving the blood into a quantity of warm water, and the red globules are diffused through the water, and give a tinge to it, while the gluten concretes into fibres like cobwebs, which can be collected. In inflammatory diseases this coagulable lymph is more easily distinguishable from the rest of the blood: when it is let in a full stream into a vessel of a globular form, the upper part of it becomes of a whitish colour, like tallow imperfectly melted, or when it is passing from a state of fusion to a state of solidity. This is occasioned by the substance of the red globules, and from its being occupied chiefly by the coagulable part, which concretes and gives firmness and density to the upper part of the blood. This appearance, which is so remarkable in inflammatory diseases, has given occasion to a great many attempts to explain it; but it is not easy to give a full and satisfactory account of it.

## MX.

Some of the phenomena with respect to the blood can be explained from the nature of this fluid, and the circumstances which are found to promote or retard its coagulation. The blood does not show this so readily if it runs slowly from the orifice, and it is not so apt to appear in the blood last drawn from the vein as in that which is first drawn. This is accounted for from an alteration in the action of the vessels; that in general the more vigorous their action is, the coagulation is so much the later. And since the pulse is weakened even during the course of the blood letting, and the action of the vessel diminished, the blood is disposed to coagulate



so much the sooner ; so there is less time for the separation of the red globules. It is probable also that the greater cooling of it, the diminution of its heat must have a tendency to give the serum a thicker consistence, and dispute the blood less for the regular separation.

## MXI.

With regard to the action of acids and alkalies upon the blood, some of the saline substances have been found to produce very remarkable effects upon it. Some of the neutral salts prevent the coagulation, so they preserve it fluid, as Glauber's salt, common salt, &c. These being added to the blood, preserve it fluid, and the red globules subside ; and pouring off the part which is free of globules, and diluting it with water, it recovers its power of coagulating ; so we can see the coagulation of the gluten quite free from the red globules. Other saline compounds, again, promote the coagulation of the blood.

## MXII.

The only remaining part is the red globules : the nature of these is still an object worthy of farther enquiry, though their colour is allowed to depend on a small proportion of iron, in a state of oxydation. They can be dissolved in water, but not in spirit of wine or oils ; or adding a small quantity of a neutral salt to water, as muriate of ammonia, they continue separate, retaining their usual form ; but mixed with pure water they give a transparent red tinge to it, and the globules are completely dissolved.

## MXIII.

Thus the blood is composed of three principles, gelatin, albumen, and fibrine, with oxyd of iron and a few neutral salts, having soda and lime for their base ; and from these principles this fluid, and of course all the other parts of animals, are formed. It partakes accordingly of all the properties which distinguish these principles. It suffers coagulation by heat, by alcohol, and by acids ; an alteration of its colour comes from the application of the gases. When decomposed by heat it

affords the same products as its separate principles, viz. empyreumatic oil, carbonate of ammonia, carbonated and sulphurated hydrogen, Prussic acid; while from the macerated mass remaining is procured phosphate of soda and lime, carbonate of lime, and oxyd of iron.

## MXIV.

On the change the blood acquires by the application of the gases, the important function of respiration depends. The blood transmitted to the heart from the veins is of a dark red colour; the blood transmitted from the lungs to the heart has a florid red appearance. These changes depend, as we shall afterwards trace, on the absorption of vital air, and the separation of carbonic acid and hydrogen in return.

## MXV.

The effects of putrefaction upon the blood deserve also attention. The disposition to coagulate is diminished or destroyed by it. This has been observed to take place to a certain degree in the living body, as in the scurvy and putrid fevers, though there is a debility and other circumstances most favourable for the coagulation. As the putrefaction advances to a greater degree it becomes thinner, and emits a disagreeable smell from the ammoniacal gas. A gross feculent sediment falls to the bottom, and the greatest part of the mass is volatilized. When the putrefaction is carried farther all the usual effects follow which attend the putrefaction of other animal substances. Some experiments have been made upon the different substances which composed the blood. When the cruor is putrified, it assumes a black brown colour; and when this is diluted with water, it gives a colour like moss water. This has occasioned a mistake with regard to the blood, and has made it to be considered as a fact that the cruor, when infused in water, is resolved entirely into serum; but there is no such change; though the cruor be diluted it still retains its red colour, and tinges the water in proportion to the quantity. It is only after a certain degree of putrefaction has taken place that the red colour disappears.

## MXVI.

When the serum is putrified by itself, it assumes a green colour, and deposits a quantity of sediment at the bottom, which has precisely the appearance of pus in ulcers, and every quality of it. Gaber obtained pus from the coagulable part of the blood. The coagulable lymph produces a purulent matter of the same kind. Thus many appearances in ulcers and abscesses have been explained entirely upon this view of the nature of pus, or its being formed from the coagulable part. The green colour too, which we observe on dead bodies, is accounted for from the serum assuming this colour when it undergoes this change. We also observe something of that green colour in the scurvy, and the high-coloured urine in inflammatory diseases partly proceed from a dissolution of some part of the red globules in consequence of a degree of putrefaction; and when the putrefaction rises higher in putrid diseases, the urine assumes a brown colour, like that given to water by the cruor when putrid.

## MXVII.

We are now to pay attention to the variety of secreted animal fluids prepared from the blood by particular organs in different parts of the body.

These naturally divide themselves into two classes, the excrementitious and useful secreted fluids, or those which are thrown out as noxious or redundant, and those prepared to serve some useful purposes for which they are fitted by their natural and useful qualities. The necessity of the first kind arises from the perishable nature of the materials which compose the bodies of animals, especially the warm animals, which are making a constant progress to decay, and a tendency to putrefaction takes place in the living body; but the parts which have undergone the least change to a state of corruption are separated from the rest and thrown out, and their place supplied by fresh particles from the blood. These secretions are three; the perspiration from the skin, the secretion of urine, and the evacuation by the intestines.

## MXVIII.

By the perspiration from the surface of the body is thrown out a subtle and volatile excretion, consisting of carbonic acid on one hand, and when more copious of lymph and saline matter, diluted with a considerable quantity of water. The first is thrown out in the form of a perfect vapour, in small quantity, and therefore invisible, but has become visible occasionally in subterraneous caverns, where the air is cold and damp. At times this discharge by the skin gives a perceptible odour, though not in general to us, our organs of smell are so dull; but dogs, in which that organ is more complete, discern the odour very completely, so as not only to distinguish one species of animals from another, but one individual from every other of the same species: so they can trace their master through a crowd; or when they see an animal, they will follow it, though it makes through a number of others of the same kind. This shows that there are peculiar matters contained in the perspiration, probably saline substances, and this is certainly attended with some of the more highly attenuated oily matter combined with water in a certain manner, as appears in fevers, and some other diseases in which the fluids are more corrupted, or the more corrupted parts are accumulated by the perspiration being obstructed. When this again is restored the patient has frequently a strong smell, and the vapour from the particular parts of the body has a strong smell, in many constitutions, in a healthy state. There are employments too, and ways of life, which give a difference, as in those who manufacture glass: in consequence of the great heat their perspiration is more copious, and by means of it much grosser substances are thrown out than in ordinary cases. Their linen is manifestly loaded with a considerable quantity of saline matter, which does not readily evaporate, but is considerably fixed.

## MXIX.

The next of these secretions is the urine, which washes out the more gross substances. There is, however, some

relation between this secretion and the perspiration, the one supplying the place of the other, in some measure and for some time, but imperfectly, and not with the continuance of health. Where a total stoppage of the urine for days is occasionally met with under disease, though the secretion of the skin and lungs undoubtedly supply its place, in some measure, yet a number of symptoms come on, from the retention of some of the parts of the urine within the body, as stupor, itching of the skin, and eruptions upon it, from some parts being sent to the skin which are too gross or irritating to pass by it; and where the secretion of the urine is deficient, it is generally attended with these consequences, eruptions of a fiery nature, which, if the stoppage is continued, show a strong disposition to mortification. The urine, therefore, from this circumstance, that its place cannot be totally supplied, and from the sensible qualities of the secreted fluid, is evidently considerably different from the perspirable matter. This is apparent when we analyze this fluid. When first discharged it is transparent, its colour pale yellow, its smell peculiar, its taste saline and nauseous. Examined at its first emission it is found slightly acid; but ammonia being soon evolved, it acquires an alkaline nature. On cooling, it loses its clearness, saline matter is separated, which its former temperature retained dissolved.

### MXX.

By evaporation urine affords a thick, brown, foetid mass, composed of empyreumatic oil, ammonia, several gases, and a portion of phosphorus; and by the retention of urine, in close vessels, a great quantity of ammonia is disengaged. By the fixed alkalies a precipitate is thrown down, composed of phosphate of lime. Gelatin is discovered by the infusion of tannin; and by using various tests the farther principles of the urine are found to consist of phosphate of soda, ammonia, lime, and magnesia, muriat of soda and ammonia, uric acid, and sometimes benzoic acid.

## MXXI.

The uric acid has been already considered; but the peculiar matter, or uree, remains still to be noticed. In this matter, the colour, odour, and principal properties of urine reside. It is obtained pure by evaporating urine to the consistence of honey, and adding alcohol for its solution. On evaporating the alcohol the residuum is diluted, with water, to the consistence of a syrup, and nitric acid then added. A compound is then formed, soluble in water, to which potash being added and evaporation employed, on the addition of alcohol, dissolves the uree, and gives it by another evaporation pure.

This matter then dissolved in water, conveys to the fluid all the peculiar properties of urine, and it is supposed to constitute about  $\frac{1}{2}$  part of this fluid. This matter is highly susceptible of decomposition, and by heat gives out ammonia and oil, in small proportion.

## MXXII.

Besides these purposes of the urine and perspiration, they separate from the alimentary matter some parts which are redundant, or of such a nature that they are incapable of being converted into good blood. When the urine is emitted not long after a meal, we perceive some degree of the flavour of the substances which were eaten, and it is plainly composed of the redundant water taken to facilitate the dissolution of the food; and from its easy reception into the vessels soon after it enters the mass of blood, a great quantity of this is separated by the secretion of the urine.

## MXXIII.

The calculi found in the urine are formed from the lithic or uric acid, a peculiar concrete acid, which can be obtained from them by solution in an alkali or precipitation in an acid. All urine contains this saline substance, which in combination with albumen constitutes calculis, and a slight change of circumstances occasion its generation. We find this matter deposited at the bottom of the glass, or other vessel, in which urine is preserved, though not forming to

hard a concretion as takes place sometimes in the bladder, and in feverish disorders it concretes into small crystals like those of salts; a cloud is formed which when held in the sun sparkles, and when examined with the microscope, or magnifying glass, appears like the crystals of neutral salts, which have had that angular figure in consequence of a particular mode of crystallization, or concretion, by which the parts of it are united together. What makes it thus concrete in these diseases is uncertain, but in other cases the circumstances are, the presence or contact of some solid matter in the urine. Experience has shown that a solid body introduced on purpose, or by accident, has given occasion to a calculus, where there was no previous disposition. Thus a bit of leaden probe which had been introduced in consequence of some venereal complaint, or a needle thrust into the bladder of a dog, have had a calculus formed upon them. In one case a small horse bean was the nucleus; how it got there is not to be traced, but probably it had been thrust in some how into the urethra; it was so entire that there was not the least doubt of its nature. If it is difficult to conceive how the matter so readily adheres to solid bodies, we should consider it similar to the crystallization of salts, which depends upon the presence of solid matter. There is always a collection of the saline particles to such bodies, as in the crystallization of vitriol, after the liquor has been obtained from the pyrites, and is saturated with iron, the workmen put into it a number of sticks; they place wooden bars over the top, and hang down from these large forked sticks; and all the clusters are formed on the internal surface of the vessel, or on the surface of these sticks, which are covered to a great thickness, and the crystallization of the urine seems to be brought on in like manner, by the contact of a solid body; though this is not an explication of the matter, yet it is a similar case, which always serves, in some measure, as an explication of the matter: and in whatever manner a solid may come to be present, something of this kind is the cause of all calculi. In calculous cases we observe generally a blackish coloured bloody matter, or mucus, which

has lost its usual appearance, by putrefaction or length of time, in the urine; this might come from the papillæ uriniferæ, or mucous glands, in the pelvis of the kidneys, in consequence of some slight inflammation, or catarrhus affection; just as blood comes from the lungs in pleurisy, or peripneumony, or from the nose in catarrh; and this may give occasion to the concretion of calculus, without occasioning pain, the kidney possessing but little sensibility.

## MXXIV.

But after the calculus is formed, an affection may dispose the kidneys to be more easily irritated; a slight catarrhal affection of the membranes may increase the sensibility to a morbid degree, and expose them to be irritated by the presence of a small calculus, and this is probably the cause of pain; where there is a small calculus in the kidney, or bladder, a slight inflammation of these parts rendering them more irritable; at least the history of Lithontriptics supports this idea: these have been considered as dissolvers of the stone, and their nature has been already treated, in the division of salts.

## MXXV.

Though the effect of putrefaction on the animal substances in general has been already treated, the putrefaction of urine deserves a little more notice, as being in some measure different from that of other animal humours. Here there is no such insupportable factor; there is no such large proportion of inflammable matter as in the blood and other humours. It is chiefly a saline matter, and the effect of putrefaction is to separate the volatile alkali combined with the other salts, so as to give a remarkable pungency to the urine; and in consequence of this, it is often employed for cleaning of clothes, the volatile alkali having the same detergent quality as fixed, and for the extracting the acid from the ore of allum, which contains another proportion of acid, and no crystallization takes place till some alkali is added to attract a portion of that acid. The other changes produced are, that the viscid or unctuous matters



are attenuated, so that the salts are more easily separated. Thus the urine is purified, from which the salt of the phosphorus is obtained.

### MX XVI.

The last of the excrementitious secretions is that performed upon the internal surface of the intestines.

The matter thrown out in this way cannot be very precisely distinguished, as it is mixed with such a quantity of the dregs of the alimentary matter, and it undergoes its degree of completion after it is secreted in its passage; but that a secretion is performed, appears from the necessity of this evacuation, independant of the quantity of food, as is well known to practitioners in the case of fevers and other diseases, in which there is a want of appetite; yet it is necessary to have the belly open to promote this evacuation, otherwise a quantity of matter is sure to accumulate, which is attended with several bad consequences; this shows that this matter derives its source partly from some other quarter, besides the excrementitious matter of the food. But further, medicines which provoke the other two secretions, provoke this also, as salts; which taken in a certain quantity, and diluted with a warm regimen, generally increase the secretion of the skin; in larger quantity, with a cooler regimen, they generally provoke the secretion of the urine; and if they are given in still greater quantity, they increase the secretion of the intestines. But further, in particular diseases, in which the fluids are constantly degenerating into a particular state of corruption, as in phthisis, they are observed to run off in this way; at first the patients are distressed with sweating; but in the end of the disease the corruption of the humours goes on more rapidly, and great quantities of it are thrown out by the intestines; the colliquative diarrhæa then comes on.

These evacuations, therefore, seem to carry off the most gross and putrid parts of our corrupted fluids and solids, which, mixed with the bile and the remains of the food, make the feculent matter.

## MXXVII.

Experiments have been made upon this fæculent matter, on the supposition that an oil might be obtained from it, capable of changing mercury into gold; and an oil has been drawn which was so different from that matter, that it had rather an agreeable smell like that of musk. This proceeded from the bilious part of the fæces probably, for the bile acquires a musky odour during its putrification. The same odour is found in the neighbourhood of dunghills, and in this country it is common to use bile, or the dung of oxen or cows which live upon grass, and have a large quantity of bile, in bleaching clothes, and it communicates a musky smell to them. The analysis, however, of the fæces shew that they consist of water, carbonated hydrogen gas, a fœtid principle, the remains of undigested food, and a mixture of intestinal liquors.

From those excrementitious secretions we come to the second division, that comprehends the useful secretions, which are prepared into proper liquors, and applied to useful purposes in the body. These may be divided into six classes, or kinds.

1. The liquors are prepared to lubricate the solids, to diminish their friction upon one another, or other hard bodies.
2. The liquor, or liquors, prepared to defend different sensible parts from acrimony of different kinds to which they are exposed.
3. The semen.
4. The nervous secretion, whatever it is, or the function performed by the brain.
5. The fluid employed by the digestion. And,
6. The milk, or nourishment, prepared for the young animal.

## MXXVIII.

The first of these are of two kinds. First, A serous, or albuminous liquor, for the purpose of lubrication. We have examples of it in the cells of the cellular membrane,

throughout the greatest part of the body. Some cells are filled with fat, but these are particular cells, the intertexture of which is intermixed with the solids of the body, and binds together with some force, but is detraçtile, allowing them to move with freedom upon one another. This has every where a quantity of serous liquor interposed between its fibres; there are some of the fibres of this contexture which contain fat, but they are particular cells, and are said to be even of a different shape. Further, we find this kind more especially present in that more compacted membrane which surrounds the tendons of muscles, and the muscles themselves, and it is called the sheath of the tendons on many occasions; and in certain recesses of these sheaths which are now called the *bursæ mucosæ*, out of which this fluid issues more plentifully, a more plentiful secretion taking place here on account of the violent motion with which these parts are agitated by the muscles. The same liquor is secreted in the ventricles of the brain. What purpose this, or even the ventricles themselves, serve, is not easily explained. The brain has motions from the pulsation of the arteries, and alternate fillings of the veins during respiration; but the motion is so small, that we cannot understand the meaning of this secretion here. Further, we find the same liquor in the pericardium, or between the surface of the heart and membranes which invest it, and over the whole surface of the pleura, and between that and the similar membrane which covers the surface of the lungs, to facilitate the sliding motion of the lungs on the surface of the pleura. We also find it in the cavity of the abdomen, interposed every where between the surface of the guts, where they are contiguous to one another or to the other viscera, and between them and the peritoneum. In all these parts there is a very simple apparatus for the secretion, merely the extremities of small arteries opening into these cavities without filling any glands, the structure of which was in any degree remarkable. When this liquor is examined, it is said to have the qualities of the serous part of the blood; it consists chiefly of water, but it contains albumen, or a

substance which is coagulable by heat; acids, and the spirit of wine. Some times when it stagnates long, it acquires a greater degree of thickness and viscosity, as in the sheaths of the tendons and bursa mucosa, and forms indolent transparent tumours, which become, at last gelatinous.

## MXXIX.

Very similar to this seems to be the secretion performed in the joints; the liquor is not exactly the same, it has a greater degree of viscosity, is rather more lubricating, and is prepared by the apparatus of a considerable gland lodged in the inside of the joint, and so situated, that the moving of the joint exposes the gland to a gentle agitation and compression, which tends to increase the secretion when it is needed, or when the joint is most used. We are told by Haller, that this is much of the same nature as that found in the cavities; it is coagulable in like manner, so consists chiefly of the serous, or albuminous part of the blood, viz. lymph with muriate and carbonate of soda.

## MXXX.

The other remarkable secretion performed to afford a liquor to defend the solid parts from natural friction, is found every where upon the surface of the skin in the cellular membrane, in which it is liable to accumulate in very large quantity, and also in the cavity of the bones. On the surface of the skin it serves to prevent the different parts from being hurt by rubbing on one another, and to prevent the skin from the irritating effects of the air. The cuticle has been considered as a curious part of the body; one use of it is to preserve the skin from the drying effects of the air; for when it is removed in the dead body there is a quick evaporation of the fluids, and the skin dries into a horny mass, while the other parts continue in their soft and plump state, and the cuticle is assisted by this fatty and sebaceous matter secreted on the surface, where there is always a certain quantity prepared for particular glands, or follicles into which the liquor is poured, and by some stagnation it acquires the qualities of an oily or sebaceous

matter. That in the cellular membrane may also answer other purposes, as much as the purpose of lubricating; at least, where it is secreted in large quantity, there it is deposited as a superfluous part of the aliment, which cannot be consumed in the performance of the animal functions, so it is deposited there, stored up to afford nourishment to the body in cases of need. This would appear from the effect of long diseases which are attended with great emaciation, and there is a great consumption of this fluid, which is quickly absorbed. That it has a great power in nourishing appears from experiments, as it has been found that fatty substances have more effect in nourishing than any other matter. This unctuous matter secreted upon the surface of the skin is in some animals attended with an odour, as musk, civet, and which seems to be of this kind. The chemical analysis of this matter shews it the same with fixed oil, as already described in p. 139.

#### MXXXI.

The second kind of secretion, to prepare a liquor to defend different parts from acrimony, is the secretion of mucus, the nature of which answers very well for this purpose. It is a viscid substance, considerably more viscid than the albuminous part of the serum; it is coagulable by heat in like manner, but it is not near so disposed to putrefaction; there is no fluid of the animal body which has less disposition to it. We have an example in some parts, where it is necessary that it should resist putrefaction; thus it is prepared upon the internal surface of the membranes of the nose and fauces, through the whole of the tract of the aspera arteria, and the whole length of the alimentary canal, and most copiously in the rectum. It is also prepared through the whole of the passages through which the urine passes. The nose is exposed to the irritating action of the air and acrid effluvia, which that organ gives the perception of; so this secretion is necessary for its defence; and it was necessary that the viscid matter should not be liable to corruption from being exposed to the air, which so much corrupts the animal substances in

general. In like manner, it is exposed in the lungs; and it is necessary, therefore, for the same reason, as in the schneiderian membrane, as also in the fauces. Its necessity is obvious through the whole of the alimentary canal, on account of the acrimony and corruption of the aliment, and particularly in the rectum, where the matter has acquired the greatest degree of acrimony. The secretion is performed there by numerous glands, or follicles which are found in the intestine; the necessity of it is as obvious in the urinary passages, particularly in the bladder, and most of all in the urethra. The nature of the glands by which this secretion is performed is much the same; they are little bags which communicate to the surface of the cavity; they have numerous vessels entering into their cavity which deposit here the fluid, from which the mucus, or inspissated lymph, is to be produced. This stagnates for some time in the follicle, suffers an absorption, and acquires the proper degree of viscosity which fits it to answer its purpose. It is impossible that this should be secreted as viscid as it is when it is applied to the surface; it is intended to protect from acrimony: so viscid a liquor could not circulate; it issues out from the minute vessels under a very great degree of fluidity, but stagnating afterwards in the cavity, the most fluid parts are absorbed, and the remaining matter acquires the proper degree of viscosity. This general remark too may be made, that a stimulus applied to the surface, or cavity for which the mucus is destined, has the effect of increasing the secretion of the glands which prepares it. As to the schneiderian membrane, it produces an increased secretion of the mucus, and so of the other parts of the body in which it is performed: whenever the acrimony is increased, the secretion of this substance, in order to obviate it, is also increased; the nature of it too is altered in consequence of diseases, and the corrupted fluids are thrown out in great quantity; so in the phthisis, or even a common catarrh, a quantity of purulent matter is sometimes thrown out in this way. There are many particular patients who throw out pus, or matter not to be distin-

pushed from it, and yet, when opened, the lungs are quite free from any ulceration; so the whole must have been secreted by the mucus glands of the lungs, and the discharge changed in its natural appearance by the absorption of oxygen. That this is possible, we have examples in common colds, particularly in the coryza; it begins with an irritation and slight inflammation in the membrane lining the nose, attended with an increased secretion of the mucous matter; after some time that inflammatory disposition is resolved in consequence of a secretion of thick purulent matter by these glands; it has all the appearance of purulent matter, as inflammations terminate in inflammatory exudations, or a secretion of purulent matter. Thus a purulent matter may be excreted by these glands, and prove a sort of crisis to the disorder.

## MXXXII.

With regard to the semen, nothing on its secretion is to be said, as the qualities of it are such as chemistry can give us no assistance in, nothing being detected in it but water, animal mucilage, and various neutral salts, as phosphate and muriat of soda, pure soda, and phosphate of lime.

4. With regard to the secretion formed in the brain, we have no conception of the fluid which is prepared there.

5. The fluids employed in the digestion of the food are chiefly the saliva in the mouth, the gastric liquor in the stomach, and the bile and pancreatic juice added after the food has passed out of the stomach.

## MXXXIII.

The saliva consists almost entirely of water, with a small quantity of albumen dissolved in it, with muriat of soda and phosphate of lime. When evaporated, the dry matter yields the same principles as the animal substances in general. It is found, that added to mixtures of alimentary substances, it moderates the fermentation these mixtures were disposed to run into. Thus dressed meat taken in different proportions, nearest to those in which they are

commonly used for food, run into a state of fermentation and are dissolved, but the saliva moderates this and prevents it from diverging so soon, either to the putrid or ascescent state. This, therefore, is one use of the saliva, though by no means the principal use of it. Sometimes it is attended with a disposition to form calculi in like manner as the urine: the hard strong stony matter, so liable to collect on the roots of the teeth, evidently proceeds from the saliva; and concretions of the same nature have been found in the salivary ducts.

## MXXXIV.

Of the gastric liquor we know still less: it is difficult to get it pure; and though it was in our power, probably we would not find it very remarkable for its obvious qualities. From experiments, however, it would appear, that digestion in the human depends entirely in this gland, which has a slightly saline taste, and is soluble in water. It possesses neither an acid nor alkaline nature, and when mixed with an acid, it is only in consequence of some morbid affection. It is not coagulated by acids or alkalies, and is but slightly so by alcohol. Its chief property is its solvent power over animal food. This is most remarkably shewn in the stomachs of carnivorous animals, much less in the graminivorous, and in a middle degree by that of man.

When subjected to chemical analysis it yields water, animal gelatin, and phosphate; when exposed to heat it gives out water, and when evaporated leaves a dry mass, affording ammonia, empyreumatic oil, and the residue contains carbon, muriat of soda, and neutral salts.

## MXXXV.

This solvent power of the gastric fluid seems also confined to dead substances, and that it cannot act upon the living ones. The proofs of this are clear from appearances which occur in the opening of bodies soon after death when we find the stomach totally dissolved; as in the opening of persons who have died a violent death; and the same thing occurs in the examination of other animals,



as in the fishes which are killed suddenly, and in the best health. It has happened, that in some dissections the stomach has been found perforated, and the death of the person has been imputed to this circumstance; but from the facts collected, it would appear that this may occur without having any connection with the disease or death of the person; and from examples, in which the disease was quite plain, all the circumstances concurred in showing its nature, for there was not the smallest complaint about the stomach; and yet immediately after death, as soon as the body cooled, the stomach was found dissolved into a mucilaginous matter, which must have been by the action of this liquor. As soon as the stomach is dead, it immediately begins to exert its power to dissolve it, to extend that power which it has over all dead substances in acting upon them as a solvent; and at length, after it has perforated the stomach, upon coming in contact with the other viscera, it will act upon them, and dissolve more or less of them.

#### MXXXVI.

The pancreatic fluid is supposed to be similar to the saliva, in consequence of some experiments, by which it was contrived to act upon the dust and insert it in a phial. Upon examination, it was found to have qualities similar to those of the saliva.

#### MXXXVII.

But the bile is considerably different, and possesses curious qualities, but is still imperfectly known. It was commonly supposed to be highly putrescent, or that it contained an acrimony in its composition, of an alkaline nature, for correcting the acid tendency of our food, and it was supposed saponaceous for keeping the union of the oily fluids with the rest; but any experiments which have been made upon it have contradicted this notion. It is not so highly putrescent as the blood and other animal fluids, neither is it saponaceous; upon being agitated with oil and water it does not dispose the oil to unite with the water.

## MXXXVIII.

To the taste the bile is bitter, and possesses a yellowish green colour; it is decomposed by acids, which are always a green colour; but its principles are best resolved by coagulating it with alcohol. If the coagulant is separated from the green liquor in which it floats, a tasteless viscid substance resembling albumen is procured, while the liquor filtrated retains the colour and taste of the bile: if again the alcohol is evaporated a concrete matter is obtained, possessing the properties of a resin, and therefore named the resin of the bile. It is generally separated by acids, in the form of a white unctuous concrete by the oxygenated muriatic acid; to these principles of the bile soda may be added, joined with carbonic acid.

This green colour of the bile from acids, explains the green purging in children, when their system is disturbed by teething and other circumstances. They often, after the first symptom of disturbed digestion, are seized with purging, and pass considerable quantities of green matter, which is bile altered into this colour by the presence of an acid.

## MXXXIX.

Biliary concretions are totally different from the concretions formed in the passages of the urine and saliva; they are called gall stones, but they are not stones; there is no earthy or stony matter in them; they are always inflammable, consisting of a sebaceous matter, which has a more solid consistence than the general run of the animal oils, and a solidity resembling spermaceti, which is a dry animal fat. It can be easily reduced to a powder, melted with heat, and concreted in like manner. The parts arrange in a number of plates, which are collected into assemblages and crystallizations, as in spermaceti. From this will be found how vain it is to attempt to dissolve these by such medicines as have been used for that purpose, which are such as have been commonly supposed efficacious in dissolving the stone in the bladder, as lime water and soap; but when

these substances are applied to gall stones, they produce no effect whatever. There is generally a remarkable crystallization from the centre towards the surface in the structure of these biliary concretions : when they are cut with a knife through the centre, we see radiated crystallizations, and often there are several orders of these. There is a nucleus of a dark coloured matter, round this there is a mass of crystallized stuff ; then, perhaps, a thin layer of brown coagulated matter, and upon that a thick crust composed of a pure sebaceous matter, and these crystallizations always stand perpendicular to the internal surface of the stone. Neither soap nor lime water, nor alkaline lees, produce any effect upon these concretions ; neither do they act upon spermaceti. They are employed in the refinement of this substance to extract the small remains of the liquid oil, and the alkaline lees unite with the oil and refuse to unite with the spermaceti.

#### MXL.

Experiments have been made upon this subject, and a solvent of these concretions has been found in a mixture of spirit of wine and oil of turpentine. Neither of these acted upon the concretion completely, when used separately ; the one divided the calculus into separable crystallizations, the other has very little action upon it ; but mixed together they produce a quick dissolution and separation of its parts ; so it has been proposed to be used as a solvent of these concretions, and a formula is given, which it is imagined has proved useful ; but it is difficult to conceive how it can reach these concretions so as to affect them. At the same time that some of these alkaline substances will not dissolve the biliary concretions, they often do service in cases of jaundice, and some practitioners lay great stress upon large doses of soap. But they cannot possibly give relief by dissolving the concretions, for they cannot reach the biliary ducts in such a short time as is found to be necessary for obtaining relief. Their power, however, may be in consequence of the stimulus with which these medicines affect the duode-

num. In general, throughout the body, wherever a liquor is secreted, if that part of the body be irritated, the secretion is increased, there is some connection of sensibility between that part and the organ of secretion, by which the secretion is greatly increased; as when the eye is irritated there is a greater secretion of tears; if the nose is irritated, there is a greater secretion from the mucous glands there. Now jaundice may arise from a collection of viscid matter, inspissated mucus, &c. stopping up the passages of the bile, &c. and a smart stimulus applied may be effectual in procuring an increased secretion of the bile, which will open the passages. Or the jaundice may arise from a spasm, which is sometimes removed too by a stimulus to a neighbouring part. These concretions, when analysed along with the resin of the bile, contain benzoic acid and small portions of lime, soda, and ammoniacal salts. Upon the whole, it is plain that the subject of the bile is still open for much enquiry.

## MXLI.

The milk now only remains, which is composed of water, holding dissolved in it a saline matter, approaching in its nature to sugar, a very bland oil, and a coagulable part of the same nature with the coagulable part of the serum. This is the medium for mixing the oil with the watery part into an emulsion, and by mixing similar ingredients artificially together, a very exact imitation of it can be made. It is from that coagulable matter or gluten that it derives its disposition to be coagulated by acids and heat. If it is boiled, a pellicle of coagulated matter forms at its surface, which if taken off is renewed again, and this will not dissolve in water. The serum being coagulated partly by the heat and partly by the action of the air, which produces the coagulation of the lymph, it is therefore from that principle that the milk derives its disposition to coagulate from the saline or saccharine matter. It is disposed to acescency in some kinds; it approaches nearer to sugar than in the common milk, and can be made to undergo the vinous fermenta-

tion, and it produces an inebriating liquor, as the milk of asses, mares, &c.

These principles are soon unfolded when it is allowed to stand at rest for some time. The oily part, or cream, collects on its surface; and the solid part, when it is removed and agitated for some time, becomes a concrete oil or butter, similar in its nature to the animal fat, (as detailed in p. 138.) After the separation of the cream the milk becomes ascendent, and then coagulates. When the fluid is parted from the coagulum a matter is obtained similar to animal gluten, termed cheese or coagulum, as already noticed.

The fluid, or serum of the milk, now only remains: having acquired an acidity from stagnation, and when evaporated, it affords a saline substance, or the sugar of milk. From this sugar of milk two peculiar acids are obtained, already noticed in p. 185.

In the serum, besides the sugar some neutral salts are also detected, muriate and phosphate of lime, muriate of potash and soda.

#### MXLII.

The yolk of the egg, as it serves a similar purpose to that for which the milk is intended, is much of the same nature, and has a communication with the stomach of the chicken within the bag in which it is lodged, and supplies the animal with nourishment after it is hatched, and by being diluted with water forms a fluid not unlike the milk, and can be substituted to it on many occasions; and as it contains less of a saccharine matter, it is rather safer for weak stomachs than milk is, and it is recommended in place of milk for this purpose, merely diluted with water in its raw state, and a small quantity of sugar added, to render it more agreeable. From the large quantity of coagulable matter the yolk can be employed to promote the union of more oil than what it contains with water. The oil in it, however, abounds so much, that when the coagulable matter is fixed, concreted, and the yolk dried with a gentle heat, a considerable quantity of oil is obtained by expression.

## MXLIII.

To complete the history of the animal fluids, it may be thought necessary to mention certain changes to which some of these are subject, which are the cause or consequence of contagious diseases. Barely mentioning the facts is all we can do. They depend upon causes which are not within the reach even of our imagination. The history of contagion shows that nations may preserve themselves from some destructive diseases, by keeping out of their way, and the object of their attention is a particular species of matter which must be kept out with care. If it reaches any one it throws the system into a tumult, proves fatal perhaps, and proves a source from which others around are infected, from whom again it may be propagated to millions of others; but it is something too subtle to be perceived by the senses. It is sometimes lodged in a bit of rag, and is only evident by the pernicious effects which it produces upon those who are so unfortunate as only to touch. We have a familiar example of it in the small-pox; the most minute atom of the infection is sufficient to communicate the disease to one, and through him to millions of others; but the active part is not perhaps the thousandth part of its weight: we do not know how little may suffice to produce the disease. These facts are not explicable upon any principle of which we have at present any knowledge.

The chemists give an illustration of it from the parallel example of fermentation. We cannot bring the farinaceous matter into the vinous fermentation, not even though malted, without the assistance of a ferment; but once this is applied it produces a much greater quantity of ferment; and a small quantity of this liquor added to a much greater quantity, will bring it all into the same state, and every part will answer the same purpose; but this similarity does not amount to an explication; we do not understand fermentation itself, so as to admit of its giving light to the other subjects.

## MXLIV.

*Functions of the Body.*

From this view of the constituent principles of the animal body, its functions come naturally into review.

## MXLV.

*Digestion.*

5. Food is required for the supply of these principles of the animal body detailed; it is introduced for this purpose by the mouth, and in man it is reduced there to a pulpy consistence by the teeth and its mixture with the saliva. In this state it is removed into the stomach, where new changes on it ensue. This organ differs in its shape in different animals. In man it has been compared to the bag of a bag-pipe, and here the food is converted into a soft pap, differing from the food as first introduced, and receiving the appellation of chyme.

## MXLVI.

6. This chyme, when examined, possesses new properties. New combinations of its principles must have therefore now taken place to acquire them, and the means by which these combinations have been effected we must look for in the organ into which the food has been introduced.

In doing so, we find it to depend on the action of the gastric fluid, or secretion of the stomach, which in man appears to operate equally on animal and vegetable food, which unites internally with it, and cannot be separated by filtration, and which acts rapidly in proportion to the minute division of the food and the degree of temperature. Two circumstances alone we can trace peculiar to this fluid; its holding a portion of uncombined phosphoric acid, and its possessing the power of coagulating milk. A certain quantity of the saliva seems also a necessary assistant to this fluid.

## MXLVII.

The chyme passes from the stomach into the intestines. Here it is subjected to new changes, and the effect of

these changes is to convert it partly into chyle and partly into excrement.

## MXLVIII.

Chyle is a white liquid, resembling milk, and is apparently milk in a less perfect state than when excluded from the breast. It possesses albumen, serum, and globules, like cream, with different salts, and something like the sugar of milk. Even a proportion of iron has been suspected in the form of a white oxyd.

## MXLIX.

The process of chylicification is unknown. The product is clearly separated, by a chemical change, from the chyme, and the consequence of this separation is the division of the chyme into this liquor and into an excrementitious part, which two parts continue afterwards always inseparable, and incapable of decomposing each other. What share the bile has in this separation is uncertain; but it seems necessary, to evolve completely the excrement, to prevent its absorption, and facilitate its discharge from the body. The excrement then, as well as the chyle, is a new compound, consisting of undigested food, decomposed however in its passage through the stomach and bowels, and combined with the bile and other fluids previous to its exit. Hence in the dung of graminivorous animals is found a new product, or benzoic acid.

## ML.

During this process of chylicification an evolution of different gases takes place, both in the stomach and bowels. In the former is found carbonic acid, oxygen, hydrogen, and azotic gases. The same is found in the intestines; but the two former prevail most in the stomach, and gradually lessen in the intestines, while the two latter increase in that situation the flatus for anum, consisting of carbonated hydrogen gas.

## MLI.

The chyle thus prepared is absorbed by the lacteals, and carried through them into a large reservoir, termed



the thoracic duct. In this reservoir it is mixed with another liquor, transmitted from the different surfaces and cavities of the body to the same place, named the lymph.

## MLII.

The nature of the lymph is equally uncertain with that of the chyle. It is a fluid colourless and somewhat viscid, containing albumen, and probably gelatin. But its union with the chyle, we have reason to suppose, a farther step towards the perfection or animalization of the former, and blended together they are conveyed directly into the blood-vessels, and in man to their very centre, or the heart. But in this organ they are not allowed to remain, they are immediately conveyed from it into the lungs, to undergo farther alterations.

## MLIII.

*Respiration.*

The alterations next that are necessary to be made by the lungs are the perfection of their still incomplete animalization, by the extrication of the remains of the constituent vegetable principles in their composition, and the introduction of a greater quantity of another principle not sufficiently received from the substances taken into the stomach.

The first of these is the separation from the blood of carbonic acid and hydrogen, the two chief constituent principles of vegetables; and the second, immediately on its presentation to this fluid in the lungs, is the absorption of oxygen or vital air, necessary both to effect this separation, and also to be introduced as essential to the support of the principle of life, of heat, and the regeneration of the solid parts of the system.

These changes are conspicuous by the disappearance of the chyle; 2dly, by the change of the blood itself to a florid red colour, which is clearly the effect of the absorption of oxygen; 3dly, by the blood being incapable of simulating the heat, without it receives this change; 4thly, by the temperature of all animals being in pro-

portion to their degrees of respiration; and 5thly, by the febrine, or rudiments of the solid, never existing either in the chyle or lymph till mixed with the blood, and acted upon by the process of respiration.

## MLIV.

Thus by digestion and respiration the functions of animalization take place. But the changes induced on the blood by respiration are not sufficient for the continuance of life. Farther alterations are required, and one of the chief of these is the separation of certain of its parts by the kidneys.

## MLV.

Through this organ there passes at least 15lbs. of blood in the space of each hour; and as death is soon the effect of any disease of this organ, its function is essential to existence, and from its fluid, or the urine being discharged, it is its separation from the blood that is the sole purpose of its use. The parts of the blood thus separated appear to be water and saline matter, but this saline matter produces, by the action of the kidneys, a new product, uree and uric acid, the principles of which must have previously existed in the blood, and required therefore to be separated.

## MLVI.

But besides these different changes already noticed, a something farther seems to be expelled from the blood in the general course of its circulation, by means of the small vessels situated near the surface or skin, termed the perspiration. This something seems to consist of the same matter that is discharged by the lungs. The quantity varies at different times and under various circumstances.

## MLVII.

Thus if we trace the different steps of the progress of animalization till complete, we find that the first stage consists in the formation of chyle; that the second depends on the mixture of the latter with the lymph; that the third stage is the union of these two fluids with the

venous blood on entering the heart ; that the fourth stage displays the oxydation of the lungs, or abstraction of the still unassimilated parts ; that the fifth effects, by means of the kidneys, the separation of those principles, which if accumulated would produce an excess of azote, or endanger a premature destruction of the system.

Thus the blood, perfected by these different changes, is fitted to repair the waste, and to continue the supply required. It is the storehouse from which materials are provided for all its wants. It gives for the bones phosphate of lime and gelatin ; for the soft parts febrine and albumen ; and by the process of assimilation these materials are formed according to the particular and necessary arrangement. Over this process, however, of assimilation the veil of darkness hangs. No facts can yet explain it.

The only circumstances with which we find it attended are :

1. That every assimilating organ performs its own peculiar office, whenever materials are presented to it for this purpose.

2. If these materials agree with the natural secretion of the organ, they pass into it unchanged. Thus milk is absorbed unchanged by the lacteals.

3. Assimilating organs do not produce any change on matter presented to them of a similar nature with their own. Thus blood can be transfused without any change taking place. Muscular flesh can be also incorporated ; while foreign substances produce, on the contrary, the death of the part.

#### MLVIII.

Thus assimilation is a chemical process under the influence of the action of the animal organs, and subjected to a superior agent that acts by fixed and determined laws. This agent, or the animal principle, is evidently connected with the state of the brain, but itself is not matter.

## MLIX.

*Secretion.*

But another species of assimilation not yet examined is secretion, by which the different liquors are separated for the purposes of the œconomy. Though this process is equally unknown, we find, in order to its taking place, that the blood passes through vessels of different diameters, often contracting to a very sensible degree, and carried through a very extended course. But by this mode of conveyance successive decompositions must take place, producing a variety in the nature of the different products.

## MLX.

*Decomposition.*

By the exercise of the functions for a certain time, their powers become impaired, the body decays, and death ensues; and in this case the powers of digestion and assimilation first fail, where death does not happen from extraneous causes. The extinction of life occasions a decomposition of the animal body. The chemical and mechanical agents, forming its principal support, are now the means of its destruction, and the spontaneous changes which it undergoes, from the re-action of its elements, vary according to the circumstances under which it is placed. Thus if excluded from air and moisture, it slowly decays till nothing remains but an apparent earthy matter.

If of a firm fibrous texture, and immersed in water, the soluble part of the animal substance is removed, and the rest converted into a fat substance, resembling spermaceti, the azote and phosphorus being disengaged, along with the hydrogen, and the remains of the latter, with some oxygen, uniting with the carbon to form fat.

When air is admitted, the process of putrefaction, (if assisted by a certain heat and moisture,) ensues, by which the parts entering into new combinations, pass off in the form of gas, and leave an earthy residuum behind. The chief of the gases are ammonia, phosphorated hydrogen,

fulphurated hydrogen, carbonated hydrogen, and carbonic acid, and, perhaps, some other more compound gases may be also discharged.

#### MLXI.

From the products then emitted by this process of putrefaction at the surface of the earth, changes are induced by the reception of these principles in the air, water, and soil. These changes tend to the support and nourishment of the vegetable kingdom, and thus the dissolution of the animal body only takes place, in order that it may be again revived, by passing first into the vegetable body, before resuming its original animal form.

#### MLXII.

##### *Tables of Attraction.*

Having now finished a general view of the various bodies that form the objects of chemistry, and traced the principal changes that they induce on each other in consequence of the relations their attractions bear; to facilitate the knowledge of these changes, various attempts have been made by chemists to form tables in which these various relations, or elective attractions, at once appear, both of the single and double kind, for a view of which a reference may be made to the larger systems of chemistry.

## P A R T II.

## PHARMACY.

## MLXIII.

**H**AVING now examined the various bodies of Chemistry, or the general principles of their action, we come next to pursue its application as directed to the purposes of Medicine, under the head of PHARMACY.

This is chiefly a chemical art, and consists in the collecting, preserving and preparing, for the use of the Physician, the various substances employed to act upon the human body, with a view to the preservation and restoration of health.

The first object, therefore, is to collect the various articles in the state of the greatest perfection; and this requires a knowledge of their appearance and qualities in that state, and to be able to distinguish them from one another.

To this it is difficult to give general rules. Such have been attempted, but these respect only the choice of vegetables, which having one general nature, are subject to general rules. The others are so different in their natures, that no rules can be given, except the taking each in its greatest perfection, and a knowledge of the *materia medica* and of chemistry will be the only assistance.

## MLXIV.

The general rules applied to vegetables may be reduced to the following heads:

1. That each plant be taken from such soil, climate, &c. as are best adapted to produce it in perfection ; for a difference in soil, &c. produces a wide difference in the same plant. It is difficult to believe what a variety of plants grow in every soil, as many of them are greatly diminished by circumstances which are unfavourable for their perfection, and even render them more invisible ; so with regard to the white clover and other plants which appear so suddenly when the soil is improved by proper manures, that it is generally thought strange how they came there, but they were there before, only in such a diminutive and short state that they were not visible ; so the difference of soil is of great consequence to the perfection of plants. But this rule is so general, that it rather deserves the name of a caution ; and it is impossible to be more particular, as the variety of circumstances and soils necessary to the perfection of different plants is so great.

It may be given as a general rule, that vegetables cultivated for pharmacy should not grow too near one another, or be crowded with other plants, this making a great difference in their size and perfection. Every plant requires a certain extent of soil, through which it is to seek its nourishment, and if there is a greater number together, they meet with a smaller quantity of nourishment ; and nothing is more certain from experience, than that plants too close to one another never thrive so well as when they are put at a proper distance ; so a principal part of the husbandman's art depends upon his preventing all other vegetables from growing in the same soil.

It is thought to be a proper general rule with regard to the aromatic plants, to take them from dry soils and warm situations, which give them a greater richness in the quantity of aromatic oil they contain ; and it is observed, with regard to roots, that their soil ought to be deep and open, for they will spread and expand more in proportion to its being such.

Upon the whole, many of these directions enter too particularly into the subject, and require that the druggist should become skilful in gardening and husbandry. It is

sufficient for them to judge from the size and apparent vigour, and he should direct his attention chiefly to this point; he should learn to judge from the appearance and size of the plants he has occasion to see, whether they have been improperly cultivated, and have grown in circumstances favourable to their production.

A second rule generally given is, that they should be taken up at the time of vegetation, when they are most replete with medical efficacy; and this is different with respect to the different parts of the plants, and their duration in the ground. Plants are well known to exist a longer or shorter time in the ground, many coming up and dying every year, others arriving at perfection only the second year, rising to a certain size only the first year, shooting out their stalks and producing their flowers and seeds only the second year. In others the root continues in the ground for a number of years and seasons, producing a flower and stalk every year. The first of these are called annuals; the second, biennials; and the third, perennials. Now there are particular rules for collecting these, according to the nature of the plant. The root of annual plants is in the greatest perfection at a certain time of the season, immediately at a certain time before it begins to shoot out its stalks and produce its flowers, when the leaves are in their greatest vigour, and the plant is preparing to send up its stalk; by this time the root is come to the greatest strength, size, and perfection, and after this it is spent in the stalk; and by putrefaction after this, many of the roots become hollow: the roots of the biennials are to be taken up about the same time of the second year; or sometimes some of these are taken up in autumn, as is generally the case with regard to the perennials. There are many of these which, when they have produced the stalks, flower and seed, all these parts wither and die down to the ground, and the root sends up fresh leaves, and during this time acquires a considerable increase to its thickness and perfection; whereas waiting till the spring, some part of it is wasted in the production of new leaves: so the autumn is the best



time for the choice of these roots; but these rules will not apply universally. The time of flowering of the different plants is so very various, as also the time of forming their stalks, that no general rule can be given, except when the root is at the greatest perfection, and before its strength is wasted in producing its flowers and seeds. Many of the roots do not admit of being taken up at a particular season, but at any time lose their virtue if kept out of the ground; so they must be allowed to remain all the year, and must be taken up occasionally.

## MLXV.

For taking up the herbs and leaves the rule is, to do it before the expansion of their flowers; but with regard to the hemlock, the leaves are in the greatest perfection about the time that the flowers are blowing, and now they are commonly gathered at this time. The leaves of some plants, as the marsh-mallow, containing a mucilaginous matter, which is the principal thing it is valued for, yield their matter to water best when they are taken young, as when they are allowed to grow to their full strength and size, a considerable quantity of them is converted into a woody matter.

With regard to flowers; they are best gathered when they are moderately expanded in a dry warm day; as when they are fully expanded they lose part of their subtle and aromatic matter, upon which their virtue chiefly depends, and it is more liable to be wasted in damp weather than in dry, the damp air being a greater solvent of it.

With regard to the seeds, the general rule is to take them when ripe and beginning to grow dry.

The fruits must be taken when they are ripe, unless it is ordered otherways; as in the seed of the cicuta, which is rather more efficacious than the other parts. The practice with regard to it, is to prepare an extract by boiling it with water, and it is necessary to collect it before it comes to its full maturity.

The woods and barks are in their greatest perfection in winter; but experience shows, that the best season for se-

paring the bark from vegetables is the spring, when the sap is rising in them.

## MLXVI.

Another matter is exudation, or concreted juices, which flow out of the wounds made for that purpose, or from ruptured vessels which have burst from an overcharge of fluids: these flowing slowly, are inspissated by evaporation to a solid mass, so are prepared by nature, and reduced to a state fit for preservation; and it is not necessary to attempt any rules with regard to them, except that general one to the druggists, to make themselves well acquainted with the appearances of these substances in their greatest perfection.

The choosing and collecting of vegetables being understood, the next object is to preserve these substances. With regard to many of the objects of pharmacy, this is easy; as the salts, earths, inflammable substances and metals, some are volatile, deliquescent or fluid, and require different vessels for containing them, which are well known, but they are not liable to such a change as the vegetable and animal substances, from their fermentation and putrefaction; so this part employed in the preservation of simples chiefly relates to vegetables, and the few animal substances which are used in medicine, as being those which require the most troublesome attention.

## MLXVII.

The preservation of vegetables is affected by having recourse to the several means known to stop the several kinds of corruption, and the avoiding every thing favourable to it.

In general, the means employed may be reckoned, 1. The dissipation of their humidity, and afterwards preserving them dry. This is the most general means employed; and as a very great number of vegetables are preserved in this way, it is thought an operation worthy of attention. Sometime ago it was directed, that the plant should be dried in the shade; but more attention has

shown that this is quite wrong; and in order to preserve the virtues of plants, we should dry them hastily. The heat of the sun is the most eligible, perhaps; and if they were spread out upon a board painted black, they would be dried properly, as the board receiving the heat would produce a dissipation of their humidity; but, in general, they are spread before a fire, at such a distance as not to be scorched; and if this be avoided, the more quickly they are dried the better, as they retain their volatile principles in much greater quantity, for the humid air is a powerful solvent of the aromatic parts; so hemlock dried in this manner is preferable to any other preparation of it; and such plants should be immediately bruised and corked up in glass vessels from the air, as they contain a saline matter and mucilaginous substance, which has a considerable attraction for humidity, enough to dispose them to undergo gradually some degree of corruption. We cannot have a better illustration of this than in the curation of tea, which has been a manufacture long established in some parts of the world. The leaves of this plant are dried hastily in stoves, which are covered with plates of metal, and the leaves are frequently stirred, in order to make them curl up close, so that they may not be broken in packing and unpacking; but the principal part is the drying the leaves very quickly. As soon as this is finished, they are immediately put in metallic vessels and preserved ever after, and these are as closely shut up from the air as possible.

A second mean is the covering them up from the air. Such plants as would be the worse for losing their moisture we bury under a quantity of sand, or cover them up in cellars, in order to keep them from the air and any great alteration of heat.

A third point to be attended to is, to keep off insects, which prove very destructive to animal and vegetable substances. The manner of destroying such insects is chiefly by ventilating such substances. Du Hamel observes that this is the principal method of expelling insects from grain,

by running it down from one story into another, while a stream of air is made to flow through a stream of grain. It is also necessary some times to apply heat greater than they can bear. Some of the dried roots are some times pressed upon others; though the insects attack them they are not the worse; as in jalap, of which they eat the woody part, and not the resinous, whereby it proves stronger; less serving for a dose.

## MLXVIII.

Vegetables may also be preserved by the application of antiseptics, as by salt, vinegar, and sugar. Salt and vinegar are employed in common life, as for the use of sailors, but sugar is only employed in pharmacy, either to form the condita, or candies, in the production of which the vegetable substances are boiled in the sugar; they are penetrated by the syrup, and inauasted with sugar, or in the conserves, in which the vegetable matter is beat into a pulp, and sugar added to it. This practice of making conserves is applicable to many vegetables, the virtues of which cannot be preserved in any other way; such as contain a volatile acid principle of an oily nature, as the scurvy-grass, &c. other conserves are kept which are intended for vehicles of more efficacious medicines. These are remarkable for nothing but their agreeable taste, at least they possess very little virtue; as the *conservæ rosarum*, *florum rosmarini*, *corticis exterioris aurantiorum*. Most of the syrups, honeys, jellies, &c. may be referred to this head: they are infusions, or decoctions, to which sugar is added to preserve them from further change.

After having thus considered the means by which the artists preserve the articles in the materia medica in a state of perfection, we shall next take a view of the various operations he performs upon them; and all the operations of pharmacy may be brought under two great divisions.

1. The preparatory operations. And,
2. The ultimate operations of pharmacy,

Under the first head are comprehended those by which the articles are either produced or extracted from the materials, or refined, or rendered otherways more active.

Under the second head, those operations by which the former are compounded variously or otherways adapted for the use of the patient.

### MLXIX.

1. The purification of several substances is performed by colature, and has for its object commonly the concretioned juices, or chiefly these. It is a simple purification of them from homogeneous substances. These juices are obtained from different plants by wounding them in different ways, so as to lay open different vessels for allowing them to exude their juices; and the dust, straws, and loose parts of the vegetables, from which these are extracted, are mixed with these juices, while suffering inspissation; so when we bring opium into fluidity, and pass it through a coarse cloth, a great quantity of the heterogeneous particles are separated from it. Some of these concretioned juices cannot be brought into fluidity by water, but must be liquified by means of heat, as turpentine, animal fat, &c.

### MLXX.

2. The pulverization of substances is one of the most simple and generally practised operations in pharmacy; the uses of it are evident on numberless occasions, to prepare substances for being swallowed and digested, to increase their surface that the humours of the stomach may act readily upon them, to prepare them for being easily divided into drops of different kinds, and for being mixed with one another in composition. This is so often necessary in pharmacy, that some branches of it have become separate articles; so the Peruvian bark is reduced to powder by means of a machine which is driven by horses, or water, as also the absorbent earths, of which great quantities are employed in pharmacy. This is a saving of labour, and

it affords the pulverized matter at a cheap rate: but in the form of powder it is difficult to be certain whether it may not be mixed with some other substance, whereas, in its original state we can judge whether it is pure or not.

Pulverization, as performed by the apothecary, is either done by pounding in the mortar, or by levigation on the porphory. It is promoted by sifting, and in some cases by elutriation with water, where the substance bears its application without any change of its qualities, the turbid water is poured off, taking along with it the most subtile part. The tough fibrous part of vegetables is incapable of levigation, and requires pounding or braying in a mortar, while these substances of a brittle nature are best reduced to a powder by levigation.

The pounding has this inconvenience, that the fine powder is liable to fly out of the mortar, whereby a quantity of it is lost, and it is in danger of hurting the health of the operator, as in the pulverizing *cantharides*, &c. The artist generally saves himself by tying a cloth or other spongy matter over his face, through which he obliges himself to breathe; but this is an imperfect remedy, and he often suffers considerably from the action of the acrid substances. A remedy might be found out for this, by forming a communication between the mortar and the large cavity of a barrel, to allow the air which is driven out, a place to circulate and deposit the subtile particles. The manner it comes out is plain; every time the pestle is drawn up there is a vacuity into which the external air issues, and when the pestle is thrown down it expels this air, which rises out and carries along with it the subtile particles, which are set afloat by the constant agitation. It may be possible, by a communication formed between the mortar and the cavity of this kind, to allow the motion without the operator being troubled by the subtile dust; or a small quantity of fluid may be added, which prevents these subtile parts from rising so readily; and this may do in the case of earthy bodies or metallic calces, but with regard to most vegetables, it would dispose them to cohere together. The sieves should, in general, be

covered, and they should be exceedingly fine, especially for the more acrid vegetable substances, which are of a purgative nature; for unless they are reduced to a fine powder, the particles adhere to the coats of the intestines, and increase the irritation they occasion there. It is commonly given as a rule in pounding roots, woods, and barks, to cut these substances with a sharp knife, whereby the operation is greatly facilitated. With regard to the gummy and resinous substances they are liable to acquire a degree of tenacity, so we avoid beating them with much violence, which would produce a degree of heat, and it is eligible to reduce them to powder in cold weather when they are more brittle. Some substances are more easily reducible to powder by the addition of spirit of wine; as in the case of camphire, one of the most important general rules is, that when a substance is powdered it should be done totally; as in powdering ipecacuan, bark, &c. if we only pound the half to a fine powder, and lay by the rest, we shall obtain a powder, the virtues of which will not answer to those of the vegetable substance in its entire state, the resinous part being more easily reduced to powder while the woody fibres remain the last; therefore to have them of an equal efficacy, the whole must be brought to the state of a powder, and mixed together.

The other method of levigation applies to earthy matter, or brittle metallic products; these bear the addition of water or other fluids without any change, and are reducible to a very fine powder.

### MLXXI.

Such substances as have some toughness may be managed by filing or granulation. Iron is generally taken in the form of filings, but it may be reduced to a fine powder, which is a particular mode of rusting the iron filings. We spread them in a shallow vessel covered with water and exposed to the air, whereby they are divided into a subtile black powder, but they must be covered with water, otherwise the powder becomes a rust of iron, so it is a mean for inducing a sort of metallic dissolution.

By elutriation too, the powder may be rendered finer, but this is especially used for boles and chalk: the boles are natural clays which are tinged with iron; but in their natural state they contain sand, as there is no clay earth without sand. In order to have it free of sand, which is very pernicious, it is best done by elutriation. In like manner chalk contains pyrites, flint, and other substances, but which is necessary to be separated from it.

After having thus considered two of the most general of the preparatory operations of pharmacy, we would next take a view of these which are more particular, arranging them according to the same method observed in the former part. On this plan we enter upon the exhibition of the airs.

## MLXXII.

CLASS I. *Modes of exhibiting Airs.*

The introduction of airs is new in pharmacy, and Mr. Watts' apparatus is the only mode of exhibiting them yet resorted to. This apparatus consists of an alembic, of a long pipe, conducting to the refrigeratory, of a refrigeratory of considerable size, of a hydraulic bellows, into which the gas is conveyed from the refrigeratory in order that it may be farther cooled, and of an air holder, into which a transfer pipe discharges the air from the hydraulic bellows. (Vide Bedoes on Airs, part II. p. 3.)

## MLXXIII.

*Vital Air.*

Vital air is procured by exposing simply black oxyd of manganese to a red heat, or by mixing it with two parts and a half of sulphuric acid, adding a moderate heat, when a large quantity of this air is separated. When fresh made it is rather unfit for medical use, as containing in it a quantity of the manganese suspended, and some caustic lime should therefore be well mixed in the water of the refrigeratory, or it should be kept 12 hours in the air holder before it is used. In using it is sometimes employed, in urgent cases, undiluted but more com-



monly it is mixed with atmospheric air, from 20, 30, to 50 quarts of atmospheric air with two of vital air, employed once a day, is a common course in chronic diseases, gradually lessening the frequency of its application, according to circumstances, and even intermitting occasionally, when general appearances of inflammation, as a white tongue, &c. appear.

The effect of this dose is to diffuse a sense of warmth through the body, and to occasion a suffusion of colour over every part, and to render the pulse slower and fuller.

#### MLXXIV.

##### *Dephlogisticated Nitrous Air*

Is obtained by exposing nitrous gas to wetted iron filings, or moist sulphuret of alkali. It may be inhaled either pure, or in a varied proportion with atmospheric air, according to circumstances.

#### MLXXV.

##### *Carbonic Acid Gas, or Fixed Air,*

Is obtained in its purest state, by heating chalk or calcarious substances red hot, and admitting to it small quantities of water, by which the fixed air will be disengaged; or it may be procured by pouring dilute sulphuric acid on chalk, and allowing the gas to pass through water, and be inspired through a tube in that state.

These inhalations may take place for 20 minutes, occasionally breathing an inhalation of atmospheric air, and they may be repeated four or five times a day, unless pain of chest, or other symptoms arise, that occasion it to be desisted from.

#### MLXXVI.

##### *Hydro Carbonate Air*

Is a modification of the former, and procured by heating charcoal to redness, and dropping water upon it. The water should be admitted very slowly, and lime should be mixed in the water of the refrigeratory, to prevent any contamination in the process, and this air is

best used fresh made. From the great powers of this air it requires, in using it, that the dose be measured out with great accuracy, and its proportion should not be more than one part to 15 of atmospheric air.

The utmost care should be taken in preparing it that the charcoal be previously well calcined.

## MLXXVII.

The exhibition of airs is still as medicines in an undetermined state. Their palliative powers are clearly proved, their radical efficacy is uncertain. To facilitate their exhibition, an arrangement of different standards or changes of atmospheric air has been proposed by Dr. Bedoes in the following manner:—

Thus 28 parts being the proportion of vital air usually present in the atmosphere, he has altered it by the addition of successive equal parts of it to one of oxygen, thus:—

TABLE I.

					Oxygen.	Azotic.
1 part of atmospheric	to 1 of oxygen	-	64	-	36	
1 of atm.	- to do.	-	52	-	48	
3 do.	- to do.	-	46	-	54	
4 do.	- to do.	-	42	-	58	
5 do.	- to do.	-	40	-	60	
6 do.	- to do.	-	38	-	62	
7 do.	- to do.	-	37	-	63	
8 do.	- to do.	-	36	-	64	
9 do.	- to do.	-	35	-	65	
10 do.	- to do.	-	34½	-	65½	
11 do.	- to do.	-	34	-	66	
19 do.	- to do.	-	30½	-	62½	

TABLE II.

The standard is altered in the following manner, by addition of successive equal parts of oxygen to one of atmospheric air:

			Oxygen.	Azotic.
2 oxygen	- to 1 atmospheric	-	76	24
3 oxygen	- to do.	-	81	19

			Oxygen.	Azote.
4 oxygen	-	to 1 atmospheric	- 85	- 15
5 do.	-	to do.	- 88	- 12

TABLE III.

*Effect of the addition of different portions of atmospheric to one of unrespirable air.*

			Oxygen.	Unrespir.
1 atmospheric	-	to 1 unrespirable	- 14	- 86
2 do.	-	to do.	- 19	- 81
3 do.	-	to do.	- 21	- 79
4 do.	-	to do.	- 22	- 78
5 do.	-	to do.	- 23	- 77
6 do.	-	to do.	- 24	- 76
7 do.	-	to do.	- 24	- 76
8 do.	-	to do.	- 25	- 75
9 do.	-	to do.	- 25	- 75
0 do.	-	to do.	- 25 $\frac{1}{2}$	- 74 $\frac{1}{2}$

TABLE IV.

*Effect of the addition of different portions of unrespirable airs to one of atmospheric.*

			Oxygen.	Unrespir.
1 atmospheric	-	to 2 unrespirable	- 9	- 91
1 do.	-	to 3 do.	- 7	- 93
1 do.	-	to 4 do.	- 5 $\frac{1}{2}$	- 94 $\frac{1}{2}$
1 do.	-	to 5 do.	- 5	- 95

The higher standard of atmosphere is chiefly exhibited in spasmodic diseases, particularly of the chest, and where the powers of the smaller vessels are in a state of a tonic weakness, as in dropsy. The lower table has been more variously modified, according to the circumstances of the disease. In phthisis an excess of carbonic acid gas has been recommended in the day, and the inspiration of hydrogen at night.

## MLXXVIII.

CLASS II. *Modes of exhibiting Waters.*

Waters are of two kinds, simple and compound.

MLXXIX.

*Simple.*

Simple water is that freed from all extraneous matter, either by distillation or filtration; as

MLXXX.

AQUA DISTILLATA.

*Lond.*

*Distilled Water.*

Take of

Spring water, ten gallons.

Draw off by distillation, first, four pints; which being thrown away, draw off four gallons. This water is to be kept in a glass or earthen bottle with a glass stopper.

AQUA DISTILLATA.

*Edin.*

*Distilled Water.*

Let spring or well water be distilled in very clean vessels till about two thirds are drawn off.

Most medicines are made up with distilled water, which should be kept in a close vessel. Filtration may be conducted equal to distillation for procuring water in a pure state, when it is passed through a bed of charcoal, according to a new apparatus invented for this purpose, and for which a patent is obtained.

MLXXXI.

*Compound.*

The compound waters used in medicine, or those impregnated with various substances, may be divided into the mineral waters, and distilled,

MLXXXII.

*Mineral Waters.*

The artificial impregnation of water, so as to answer the purpose of the natural mineral springs, described in the former part, is of much importance, and this is easily done by an accurate knowledge of their ingredients.

## MLXXXIII.

*Acidulous Waters.*

The first class, or the acidulous waters, depend entirely on the carbonic acid, as their active principle, and they contain from  $\frac{1}{100}$  part to a quantity equal to their bulk of it. They are prepared by Dr. Nooth's machine, which has since received the successive improvements of Parker and Magellan. The materials, consisting of chalk or marble, and diluted sulphuric acid, are then to be successively introduced into its lower part, the latter first. The effervescence will then begin, and the impregnation take place. A proportion of neutral salts may be afterwards dissolved in the water. Thus in order to make the Seltzer, 6 grains of carbonate of magnesia, 5 grains of mineral alkali, and 22 grains of muriated soda are to be added for each pint of water. By ascertaining the proportions of the neutral salts in each water the same imitation may be made.

## MLXXXIV.

*Saline Waters.*

The active ingredients in this class of waters is either the sulphate of magnesia, or else sulphate of soda. In the Epsom mineral a pint contains two scruples of sulphate of magnesia, and in this proportion it may be imitated. In sea-water the preparations are, in a pint, of muriate of soda 186 grains, of muriate of magnesia 51 grains, and of sulphate of lime 7 grains. But the sulphate of magnesia is the active ingredient.

## MLXXXV.

*Sulphureous Waters.*

The sulphureous hydrogen is the distinguishing ingredient of this class, united with a proportion of carbonic acid gas and azote. The Aix water is one of the most powerful of this class, and it may be imitated by first impregnating the water with carbonic acid, then adding a dram or two of hepar sulphuris, or alkaline

sulphuret, in powder, with sulphuric acid; and the gaseous quality being thus imparted, add to each pint 6 grains of muriate of soda, 14 grains of carbonate of soda, and 5 grains of carbonate of lime.

## MLXXXVI.

*Chalybeate Waters*

Are distinguished by their proportion of iron generally dissolved in carbonic acid. They are therefore a mixture sometimes of the acidulous, sometimes of the saline, sometimes of both waters, holding a solution of steel; and to imitate them, it is only necessary to suspend two or three plates of iron in the water, when impregnating it with carbonic acid, the saline ingredients may then be added, which in the Pyrmont water are 9 grains of carbonate of magnesia, 5 grains of sulphate of magnesia, and 2 grains of muriate of soda, to every pint.

## MLXXXVII.

By preparing the mineral waters in a close metallic vessel, they may be procured of any temperature.

That this subject of the operation of the ingredients contained in the principal mineral waters in use may be shewn at one view, and thus render their artificial imitation easy, a synoptical table is given of them, chiefly extracted from Dr. Saunders' work.

# A SYNOPTICAL TABLE.

CLASS.	NAME.	Highest temp. — Fahren.	Contained in an English wine pint of 28.875 cubic inches.					Oxyd of iron. — grains.	Doses.
			Azotic gas. — cub. in.	Carbonic acid gas. — cub. in.	Sulph. hydrog. — cub. in.	Carbon. soda. — grains.	Neutral purging salts. — grains.	Selenite and tartar. — grains.	
Simpler cold	Malvern			uncert.	none	none	uncert.	uncert.	none
	Holywell				none	none	uncert.	uncert.	Quarter of a pint twice a day
Simpler thermal	Bristol	74°	uncert.	3.75	none	none	2 81	3.16	none
	Matlock	66°		uncert.	none	none	uncert.	uncert.	Ditto.
	Buxton	82°	0.474	uncert.	none	none	0.25	1.625	none
Simple saline	Sedlitz			1.	none	none	185.6	8.68	none
	Epflom				none	none	40.2	8.2	none
	Sea				none	none	237.5	6.	none
Highly carbon- ated alkaline	Seltzer			17.	none	4-	17.5	8.	none
	Turbidg		0.675	1.325	none	none	0.344	0.156	1/2 pint thrice a day.
Hot, carbonated	Bath	116°	1.8	1.2	none	none	15	10.2	1/2 pint thrice a day.

# A SYNOPTICAL TABLE.

Contained in an English wine pint of 28.875 cubic inches.										
CLASS.	NAME.	Highest temp. — Fahren.	Azotic gas. — cub. in.	Carbonic acid gas. — cub. in.	Sulph. hydrog. — cub. in.	Carbon. foda. — grains.	Neutral purging salts. — grains.	Selenite and earthy carbonates. — grains.	Oxyd of iron. — grains.	Doses.
Highly carbonated chalybeate	Spa			12.79	none	1.47	4.632	1.47	0.56	$\frac{1}{2}$ pint thrice a day.
	Pyrmont			26.	none	none	7.13	22.075	0.46	The same.
Saline carbonated chalybeate	Cheltenham		uncert.	5.687	uncert.	none	62.125	6.85	0.625	Dose $\frac{1}{2}$ pint.
	Scarbro'			uncert.	none	none	20.	10.	uncert.	The same.
Hot, saline, highly carb. chalybeate	Vichy	120° ?		uncert.	none	uncert.		uncert.	uncert.	The same.
	Carlsbad	165°		uncert.	none	11.76	47.04	4.15	uncert.	The same.
Vitriolated chalybeate	Hartfell				none	none	none	none	4.815*	Pint in the day.
Cold sulphureous	Harrigate		0.875	1.	2.375	none	91.25	3.	none	2 pints a day.
	Moffat		0.5	0.625	1.25	none	4.5	none	none	Ditto.
Hot, alkaline, sulphureous	Aix	145°		uncert.	uncert.	12.	5.	4.75	none	Half a pint.
	Bariet	132°		uncert.	uncert.	uncert.	uncert.		none	The same.
	Barege	120°			uncert.	2.5	0.5	uncert.	none	The same.

\* That is, 2.94 contained in the sulphate of iron, (this salt when crystallized containing 28 per cent. of oxyd of iron, according to Kirwin) and 1.875 additional of oxyd of iron.



Distilled waters consist of those impregnated with the aromatic parts of certain vegetables, and this impregnation is procured by distillation, which is performed in three ways, by the cold still, by the hot still, and by the union of both.

The first method consists in filling a shallow leaden vessel with the fresh herbs and flowers, which are heaped above it; so that when the head is fitted on, this also may be filled a considerable way. A little fire is made under the vessel, sufficient to make the bottom much hotter than the hand can bear, care being only taken not to heat it so far as to endanger scorching any part of the subject. If the bottom of the vessel be not made so hot as to have this effect on the part contiguous to it, there is no fear that the heat communicated to the rest of the included matter will be so great as to do it any injury. By this management, the volatile parts of the several odorous plants, as mint, are effectually forced over; and if the process has been skilfully managed, the distilled liquor proves richly impregnated with the native odour and flavour of the subject, without having received any kind of disagreeable impression from the heat used.

This method is too slow for the dispatch of business, and therefore the hot still is more employed. This consists in adding to the plant a quantity of water, to prevent its burning; and the liquor is kept nearly of a boiling heat, or made to boil fully, so that the vapour rises plentifully into the head, and passing thence into a spiral pipe or worm placed in a vessel of cold water, is there condensed, and runs out in drops quickly succeeding each other, or in a continued stream. The additional water does not at all weaken the produce; for the most volatile parts of the subject rise first, and impregnate the liquor that first distils: as soon as the plant has given over its virtue sufficiently, which is known by examining from time to time the liquor that runs from the nose of the worm, the distillation is to be stopped.

This method though most proper for the officinal preparations, from the degree of heat employed, is apt to injure those plants of a more delicate flavour, and on this account for the latter the compound method is preferred, by which are obviated the inconveniences of the former. A quantity of water being poured into the still, and the herbs or flowers placed in a basket over it, there can be no possibility of burning; the water may be made to boil, but so as not to rise up into the basket, which would defeat the intention of this contrivance. The hot vapour of this water passes gently through all the interstices of the subject matter, imbibes and carries over the volatile parts unaltered in their native flavour. By this means the distilled water of all those substances whose oils are of the more volatile kind, are obtained in the utmost perfection, and with sufficient dispatch.

## MLXXXIX.

In making distilled waters, the rules to be observed are:

1. That fresh herbs be distilled with three times their weight of water, but dry ones require a much larger quantity; and as no invariable rule can be offered, the distillation should be always continued so long as the liquor runs well flavoured.
2. The distillation may be either conducted in a common still, or in an alembic and refrigeratory, with the junctures well luted.
3. The distillation of the water is succeeded by an acid liquor coming over, which frequently oxydates part of the vessel.
4. Oil should be carefully taken off from the surface of the distilled water.
5. In order that such distilled waters may keep, a  $\frac{1}{20}$  part of proof spirit has been directed to be added to them, or half an ounce to each pound.

The list of distilled waters is now much lessened in practice. They are employed chiefly as grateful diluents, as suitable vehicles for medicines of greater efficacy, or

for rendering disgusting ones more acceptable to the palate and stomach. Few are depended on, with any intention of consequence, by themselves.

## AQUA ANETHI.

*Lond.*

*Dill Water.*

Take of

Dill-seed, bruised, one pound ;

Water, sufficient to prevent an empyreuma.

Draw off one gallon.

## AQUA SEMINUM NESTI.

*Edin.*

*Dill-seed Water.*

Take of

Dill-seeds,     ' pound ;

Pour on as much water as when ten pounds have been drawn off by distillation, there may remain as much as is sufficient to prevent an empyreuma.

After proper maceration, let ten pounds be drawn off.

In this water two colleges pretty much agree. Though a powerful impregnation, it is little employed as a comminative, from its flavour being less agreeable than to some others.

## AQUA CINNAMONI.

*Lond. Ed.*

*Cinnamon Water.*

Take of

Cinnamon, bruised, one pound ;

Water, sufficient to prevent an empyreuma.

Macerate for 24 hours, and draw off one gallon.

This water the most cordial and fragrant of the whole when made from cinnamon and not cassia, requires a quick fire and low vessel ; and in order to prevent the separation of its oil afterwards, a small addition of sugar.

## AQUA CASSIÆ LIGNÆ.

*Edinb.*

*Cassia Water.*

From a pound and half of the cassia bark, ten pounds of water are directed to be drawn off in the same manner as the Dill water.

This is prepared oftener from the buds than bark, and is a common substitute for the former, to which from the strength of its impregnation it is not inferior.

**AQUA FÆNICULI.**

*Edinb.*  
*Fennel Water.*

Take of

Sweet fennel-seeds, bruised, one pound;

Water sufficient to prevent an empyreuma.

Draw off one gallon.

This water is a pleasant carminative, and better prepared from the seeds than any other part of the plant.

**AQUA MENTHÆ P. ERITIDIS.**

*Edinb.*  
*Peppermint Water.*

Take of

Peppermint, dried, one pound and an half;

Water, sufficient to prevent an empyreuma.

Draw off one gallon.

This is a pungent useful cordial in flatulence and colic, taken from half an ounce to an ounce. It may be prepared also by the essential oil and water, with the intervention of sugar.

*Edinb.*

Put three pounds of fresh peppermint in flower, ten pounds of water and to be drawn off.

**AQUA MENTHÆ SATIVÆ.**

*Edinb.*  
*Spearmint Water.*

Take of

Spearmint dried, one pound and an half;

Water, sufficient to prevent an empyreuma

Draw off one gallon.

This water is much used warm against weakness of stomach and vomiting.

**AQUA PIMENTO.**

*Edinb.*  
*All-Spice Water.*

Take of

All spice, bruised, half a pound;

Water, sufficient to prevent an empyreuma.

Macerate for 24 hours, and draw off one gallon.

This water is a warm, useful carminative, and is much employed, from its cheapness, in hospital practice.

## AQUA PULEGII.

*Lord. Edinb.*

*Penny-Royal Water.*

Take of

Dried penny-royal, one pound and a half;

Water, sufficient to prevent an empyreuma.

Draw off one gallon.

The penny-royal water is now little used, though formerly much respected in hysterical cases.

## AQUA ROSÆ.

*Lord. Edinb.*

*Rose Water.*

Take of

Fresh petals of the damask rose, the white heels being cut off, six pounds;

Water, sufficient to prevent an empyreuma.

Draw off one gallon.

This water is only valued for its agreeable flavour, as its impregnation is not sufficient to possess the particular quality of the leaves in their concentrated state.

## AQUA CORTICIS LIMONUM RECENTIUM.

*Edinb.*

*Lemon peel Water.*

From two pounds of recent lemon-peel, ten pounds of water are to be drawn off by distillation.

## AQUA CORTICIS AURANTIORUM HISPALENTIUM RECENTIUM.

*Edinb.*

*Orange-peel Water.*

From two pounds of recent orange-peel, ten pounds of water are to be drawn off by distillation.

Those waters are employed in disorders of the stomach and palate, as well as a diluent in fever; but from the slightness of their impregnation little confidence is placed in them.

## PHARMACY.

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### AQUA ALEXITERIA.

*Brun.*

*Alexiterial Water.*

Take of

- Elder flowers, moderately dried, three pounds ;
  - Angelica leaves, fresh gathered, two pounds ;
- Spring water, forty pounds.

Draw off, by distillation, thirty pounds.

This is a simple, elegant water, much used as a vehicle in making other medicines.

### AQUA CAMPHORÆ.

*Brun.*

*Camphor Water.*

Take of

Camphor, an ounce and an half.

Let it be dissolved in half an ounce of spirit of rosemary, then pour on it two pounds of spring water, and draw off by distillation a pound and an half.

The introduction of this medicine in the diluted state of a water has been tried with great advantage.

### AQUA CASTOREI.

*Brun.*

*Castor Water.*

Take of

Russia castor, one ounce ;

Water, as much as will prevent burning.

Draw off two pints.

As water receives a full impregnation of this medicine whose virtues reside in an essential oil, it is properly introduced in this form in hysteric and other nervous cases, though its qualities are impaired by keeping.

### AQUA CEREFOLII.

*Gen.*

*Chervil Water.*

Take of

Fresh leaves of chervil one pound ;

Spring water, as much as is sufficient for allowing eight pounds to be drawn off by distillation, at the same time avoiding empyreuma.

Though an elegant form of exhibiting the medicine, it is inferior in its virtue as a diuretic, to the substance, or expressed juice.

## PHARMACY.

## AQUA CERASI.

*Succ.**Black Cherry Water.*

Take of

Ripe black cherries, bruised with the kernels, twenty pounds;

Pure water, as much as is sufficient for avoiding empyema.

Draw off twenty pounds by distillation.

This is often used as a vehicle for other medicines, especially in the convulsions of infancy; but it is alleged at the same time to possess something of a poisonous nature, and to resemble the lauro cerasus.

## AQUA CHAMOMELI.

*Dan.**Chamomile-flower Water.*

Take of

Chamomile flowers, dried in the shade, eight pounds;

Water, seventy-two pounds.

Draw off by gentle distillation forty-eight pounds.

This water requires some previous fermentation of the flowers before being distilled, and they give over in this form the smell and flavour of the medicine, without any of the bitterness. It is a remedy in flatulent cholick and other similar complaints.

## AQUA FRAGORUM.

*Succ.**Strawberry Water.*

From twenty pounds of strawberries twenty pounds of distilled water are drawn off, according to the same directions given for the preparation of the black cherry water.

The agreeable flavour of this form is its only recommendation.

## AQUA HYSSOPI.

*Succ.**Hyssop Water.*

From four pounds of the fresh leaves of hyssop, six pounds of water are drawn off.

This water has been esteemed as a uterine and pectoral medicine, but on no just foundation.

AQUA LILIORUM ALBORUM.

*Brun.*

*White Lily Water.*

To any quantity of these flowers, four times their weight of water is to be added, and water drawn off by distillation in the proportion of two pounds to each pound of the flowers.

This water resembles the odour of the growing flowers, but is of no particular application in disease.

AQUA MELISSÆ.

*Brun.*

*Balm Water.*

The green leaves of the balm are to be macerated with double their weight of water; and from each pound of the plant a pound and an half of water is to be drawn off.

This water has been recommended in nervous cases, on an empty stomach, but does not appear to deserve the character.

AQUA RUTÆ.

*Rofs.*

*Rue Water.*

From each pound of rue, with a sufficient quantity of spring water to prevent an empyreuma, two pounds of distilled water are to be drawn.

This form possesses both the smell and pungency of the vegetable, and is therefore active in these nervous cases, and other affections from interrupted discharge, where the substance itself is employed.

AQUA SABINÆ.

*Brun.*

*Savin Water.*

This is distilled from the fresh leaves of savin, after the same manner as the former.

This water possesses much the same qualities as the former, and is employed in much the same cases.

AQUA SAMBUCI.

*Brun.*

*Elder-flower Water.*

This is distilled from fresh elder flowers, after the same manner as the white lily water.

This water is seldom used, though strongly fragrant of the flowers.



## AQUA SALVIZÆ.

*Brun.**Sage Water.*

This is directed to be prepared from the green leaves of the sage, in the same manner as the balm water.

This water contains all the virtues of the simple, and an infusion can be easier made, and is equally powerful.

*Distilled Spirits.*

These are formed by the solution of the essential oil of vegetables in alcohol, which keeps it by distillation suspended, instead of its separating from its menstruum, as in the waters.

To render these spirits fit for the purposes of medicine, the alcohol, or rather proof spirit, should be rectified as directed in p. 127 and 190, and in the following receipts.

## SPIRITUS VINI RECTIFICATUS.

*Edinb.**Rectified Spirit of Wine.*

Take any quantity of French brandy, and with a very gentle heat distil it to one half.

This rectified spirit, being digested for two days with one fourth its quantity of dry salt of tartar in powder, and then distilled in a glass cucurbit with a very gentle heat, becomes ALCOHOL.

Spirits distilled from malt liquors, or other fermented substances, after being rectified in the above method, require further purification; namely, repeated distillation from an equal quantity of spring water.

Having thus procured a proper rectified spirit, it becomes fit for the various compositions to be detailed.

## SPIRITUS VITRIOLI DULCIS.

*Lond.**Dulcified Spirit of Vitriol.*

Take of

Rectified spirit of wine,  
Vitriolic acid, each one pound.

Pour in by a little at a time the acid to the spirit, and mix them by shaking; then from a retort into a tubulated receiver, to which another recipient is fitted, distil the spirit of vitriolic æther till sulphureous vapours begin to rise.

ACIDUM VITRIOLICUM VINOSUM vulgo SPIRITUS  
VITRIOLI DULCIS.

*Edinb.*

*Vinous Vitriolic Acid, commonly called Dulcified Spirit of Vitriol.*

Take of

Vitriolic æthereal liquor, one part :

Rectified spirit of wine, two parts.

Mix them.

This medicine we have already noticed in p. 192, and its mode of preparation. It is greatly used both as a menstruum and a medicine. It is the best solvent of any substance of a resinous and saponaceous nature. As a medicine the discharges by the skin and kidneys are promoted by it, and it relieves pain, spasm, and flatulence. Its dose is from 10 to 80 or 90 drops in a proper vehicle.

ÆTHER VITRIOLICUS.

*Lond.*

*Vitriolic Æther.*

Take of

The spirit of vitriolic æther, two pounds;

Water of pure kali, one ounce.

Shake them together, and distil, with a gentle heat, fourteen ounces by measure.

LIQUOR ÆTHEREUS VITRIOLICUS.

*Edinb.*

*Vitriolic Æthereal Liquor.*

Take of

Rectified spirit of wine,

Vitriolic acid, of each thirty-two ounces.

Pour the spirit into a glass retort fit for sustaining a sudden heat, and add to it the acid in an uniform stream. Mix them by degrees, frequently shaking them moderately : this done, instantly distil from sand previously heated for that purpose, into a receiver kept close with water or snow. But the heat is to be so managed, that the liquor shall boil at first, and continue to boil till sixteen ounces are drawn off; then let the retort be raised out from the sand.

To the distilled liquor add two drams of the causticum commune acerrimum; then distil again in a highly raised retort, with a very gentle heat, into a cool receiver, until ten ounces have been drawn off.

If sixteen ounces of rectified spirit of wine be poured upon the acid remaining in the retort after the first distillation, an æthereal liquor may be obtained by repeating the distillation. This may be done pretty often.

This is the most volatile of all spirits, and inflammable

of all liquids, capable of the most sudden evaporation, and forming a powerful solvent of oils, balsams, and resins. Its progressive odour is largely diffused. As a medicine it is much employed in spasmodic cases, as tooth-ach, head-ach, and asthma. Its dose extends from a few drops to half an ounce, in a glass of wine or water, to be immediately swallowed.

## SPIRITUS ÆTHERIS NITROSI.

Lond.

*Spirit of Nitrous Æther.*

Take of

Rectified spirit of Wine, two pints;

Nitrous acid, half a pound.

Mix them, by pouring in the acid to the spirit, and distil, with a gentle heat, one pound ten ounces.

## ACIDUM NITRI VINOSUM; vulgo SPIRITUS NITRI DULCIS.

Edinb.

*Vinous Acid of Nitre, commonly called Dulcified Spirit of Nitre.*

Take of

Rectified spirit of wine, three pounds;

Nitrous acid, one pound.

Pour the spirit into a capacious phial, placed in a vessel full of cold water, and add the acid by degrees, constantly agitating them. Let the phial be slightly covered, and laid by for seven days in a cool place; then distil the liquor, with the heat of boiling water, into a receiver kept cool with water or snow, till no more spirit comes over.

This dulcified spirit of nitre is much used in promoting the excretions and fortifying the stomach. It is given from a few drops to a dram. With a proportion of alkaline spirit it forms a powerful diaphoretic, and occasionally diuretic. Added in small quantities to malt spirits, it gives the flavour of brandy.

## SPIRITUS AMMONIÆ.

Lond.

*Spirit of Ammonia.*

Take of

Proof-spirit, three pints;

Sal ammoniac, four ounces;

Pot-ash, six ounces.

Mix, and distil, with a slow fire, one pint and a half.

**SPIRITUS SALIS AMMONICI VINOSUS.**

*Edinb.*

*Vinous Spirit of Sal Ammoniac.*

Take of

Quicklime, sixteen ounces;

Sal ammoniac, eight ounces;

Rectified spirit of wine, thirty-two ounces.

Having slightly mixed the quicklime and ammoniacal salt, put them into a glass retort; then add the spirit, and distil in the manner directed for the volatile caustic alkali, till all the spirit has passed away.

This solution of volatile alkali in spirit of wine is used as a menstruum for essential oils and to form a variety of tinctures. As a medicine its qualities are only those of the volatile alk.

**SPIRITUS AMMONIAE FOETIDUS.**

*Lond.*

*Fetid Spirit of Ammonia.*

Take of

Proof-spirit of wine, six pints;

Sal ammoniac, one pound;

Asafœtida, four ounces;

Pot-ash, one pound and an half.

Mix them, and draw off by distillation five pints, with a slow fire.

*Edinb.*

Take of

Vinous spirit of sal ammoniac, eight ounces;

Asafœtida, half an ounce.

Digest in a close vessel twelve hours; then distil off, with the heat of boiling water, eight ounces.

This spirit is reckoned the most useful anti-hysterical medicine in practice. Its colour is improved by keeping.

**AQUA MELISSÆ COMPOSITA.**

*Compound Balm Water, commonly called Eau de Carmes.*

Take of

Balm in flowers, fresh gathered and cleared from the stalks, two pounds;

Lemon-peel, fresh, as soon as pared from the fruit, four ounces;

Coriander seeds, eight ounces;

Nutmegs,

Cloves,

Cinnamon, each, bruised, two ounces;

Angelica roots, dried and bruised, one ounce;

Spirit of wine, highly rectified, ten pints.

Steep the several ingredients in the spirit four or five days; and then draw off, in the heat of a water-bath, ten pints. Rectify the distilla-

tion in a water-bath, drawing off only about eight pints and three quarters.

### SPIRITUS ROSISMARINI.

*Lond.*

*Spirit of Rosemary.*

Take of

Rosemary tops, fresh gathered, a pound and a half;

Proof spirit, one gallon

Distil in the heat of a water-bath till five pints are come over

*Edinb.*

Take of

Flowering tops of rosemary, fresh gathered, two pounds;

Rectified spirit of wine, eight pounds.

Distil in the heat of boiling water till seven pounds are come over.

This preparation is best conducted by the method we mentioned as the cold state under the class of waters. The Hungary water is a similar preparation.

### SPIRITUS LAVENDULÆ SIMPLEX.

*Lond.*

*Simple Spirit of Lavender.*

Take of

Lavender flowers, fresh gathered, a pound and a half;

Proof-spirit, one gallon.

Draw off, by the heat of a water-bath, five pints.

*Edinb.*

Take of

Flowering spikes of lavender, fresh gathered, two pounds;

Rectified spirit of wine, eight pounds.

Draw off, by the heat of boiling water, seven pounds.

### SPIRITUS LAVENDULÆ COMPOSITUS.

*Lond.*

*Compound Spirit of Lavender.*

Take of

Simple spirit of lavender, three pints;

Spirit of rosemary, one pint;

Cinnamon,

Nutmegs, each half an ounce;

Red Saunders, three drams.

Digest them together, and then strain out the spirit for use.

*Edinb.*

Take of

Simple spirit of lavender, three pounds;

Simple spirit of rosemary, one pound;

Cinnamon, one ounce;

Cloves, two drams;

- \ Nutmeg, half an ounce ;
  - / Red Saunders, three drams.
- Macerate seven days, and strain.

This is a grateful, fragrant cordial: externally, rubbed on the temples, it proves a powerful stimulus to the nerves of the skin: internally, it is given in doses of a tea-spoonful as a useful cordial.

AQUA ODORIFERA.

*An Odoriferous Spirit, called Sweet Honey Water.*

Take of

- Coriander seeds,
- Honey, each one pound ;
- Cloves, an ounce and a half ;
- Nutmegs,
- Banjoine,
- Storax, each an ounce ;
- Vanilloes, in number four ;
- Yellow rind of three lemons ;
- French brandy, one gallon.

Digest these ingredients together for forty-eight hours ; and then distil off the spirit in balneo marie. To one gallon of this spirit add,

- Orange-flower water,
- Rose water, of each one pound and a half ;
- Ambergris,
- Musk, of each five grains.

First grind the musk and ambergris with some of the water, and afterwards put all together in a large mattrafs ; shake them well, and let them circulate for three days and nights in a gentle heat ; then suffer them to cool, filter the liquor, and keep it close stopp'd up for use.

This water is a useful perfume.

SPIRITUS COCHLEARIE.

*Edinb.*

*Spirit of Scurvygrafs.*

Take of

- Fresh scurvygrafs, bruised, ten pounds ;
- Rectified spirit of wine, five pounds.

Steep the herb in the spirit for twelve hours ; then with the heat of a water-bath, distil off five pints.

This preparation is extremely pungent, and its dose from 20 to 100 drops has been recommended in dropsy. Its qualities are much diminished by exposure to the air.

AQUA ANHALTINA.

*Anhalt Water.*

Take of

- Turpentine, six ounces ;
- Olibanum, one ounce ;

Aloes wood, three ounces;  
 Cloves,  
 Cinnamon,  
 Cubebs,  
 Rosemary flowers,  
 Galangal,  
 Mastich,  
 Nutmegs, each, six drams;  
 Saffron, two drams and a half;  
 Bay berries,  
 Fennel seeds, each half an ounce;  
 Spirit of wine, five pints.

Pulverise those ingredients which require such treatment, and digest the whole with the spirit for six days; then distil, with an exceeding gentle heat, in balneo marie: the liquor which runs clear will be separated from the turbid, and kept by itself.

Where the addition of musk is required, fifteen grains thereof are to be tied in a bag, and suspended in the head of the still.

It is used externally in paralytic and rheumatic affections, and internally as a warm cordial.

#### AQUA ABSINTHII COMPOSITA.

*Compound Wormwood Water.*

Take of

Calamus aromaticus,  
 Orange-peel, fresh,  
 Cinnamon, each four ounces;  
 Roman wormwood, half a pound;  
 Mint, three ounces;  
 Lesser cardamoms,  
 Mace, each one ounce;  
 French brandy, two gallons.

Having bruised the seeds and spices, and cut the other ingredients, pour on them the brandy, and after steeping them together for the space of four days, distil off two gallons.

This is a powerful stomachic.

#### AQUA CARVI SPIRITUOSA.

*Edinb.*

*Spirituous Caraway Water.*

Take of

Caraway seeds, half a pound;  
 Proof-spirit, nine pounds

Macerate two days in a close vessel; then pour on as much water as will prevent an empyreuma, and draw off by distillation nine pounds.

In the same manner may be prepared nine pounds of spirituous distilled waters, from

Cinnamon, one pound ;  
Peppermint leaves, a pound and a half ;  
Nutmeg, well beat, two ounces ;  
Jamaica pepper, half a pound.

This forms a pleasant and useful cordial.

**AQUA ALEXETERIA SPIRITUOSA.**

*Lond.*

*Spirituous Alexeterial Water.*

Take of

Spearmint leaves, fresh, half a pound ;  
Angelica leaves, fresh ;  
Sea-wormwood tops, fresh, each four ounces ;  
Proof-spirit, one gallon ;  
Water, as much as will prevent burning.

Distil off one gallon.

**AQUA ALEXETERIA SPIRITUOSA CUM ACETO.**

*Lond.*

*Spirituous Alexeterial Water with Vinegar.*

Take of

Spearmint leaves,  
Angelica leaves, each half a pound ;  
Sea-wormwood tops, four ounces ;  
Proof-spirit, one gallon ;  
Water, as much as is sufficient to prevent burning ;  
Vinegar, one pint.

Distil the fresh herbs with the spirit and water, drawing off one gallon ;  
to which add the vinegar.

This forms a useful sudorific.

**AQUA SEMINUM ANISI COMPOSITA.**

*Lond.*

*Compound Anisif Water.*

Take of

Aniseeds,  
Angelica seeds, each half a pound ;  
Proof-spirit, one gallon ;  
Water, as much as is sufficient to prevent burning.

Draw off by distillation one gallon.

The medicine is appropriated to flatulent complaints, and is a useful cordial in debilitated stomachs, where digestion is impaired.



## AQUA CARMELITANA.

*Dan.**Carmelite Water, or Compound Balm Water.*

## Take of

Fresh-gathered leaves of balm, a pound and a half;

The white yellow rind of lemons, four ounces;

Nutmeg,

Coriander, each two ounces;

Cloves,

Cinnamon, each one ounce.

The ingredients being sliced and bruised, pour upon them

Rectified spirit of wine six pounds;

Balm water, three pounds.

Digest for three days, then draw off six pounds by distillation.

This is the spirit of rose, and to have it pure, a second distillation, or rather re-decomposition, if necessary; and to give it the flavor which all such spirits acquire by keeping, it should be plunged a short time into an extreme cold mixture, as pounded ice, and sea salt. In this way, by freezing them, are the distilled waters much improved.

## AQUA CORTICUM AURANTIORUM SPIRITUOSA.

*Land.**Spirituos Orange-peel Water.*

## Take of

Outer rind of Seville orange-peel, dried, half a pound;

Proof-spirit, one gallon;

Water, as much as is sufficient to prevent an empyreuma.

Distil off one gallon.

This is used as a powerful stomachic and carminative.

## AQUA BRYONIA COMPOSITA.

*Compound Bryony Water.*

## Take of

Bryony roots, one pound;

Wild valerian root, four ounces;

Penny-royal,

Rue, each half a pound;

Mugwort leaves,

Feverfew flowers,

Savin tops, each one ounce;

Orange-peel, fresh,

Lovage seed, each two ounces;

French brandy, two gallons and a half.

Having cut or bruised those ingredients which require such treatment, steep them in brandy four days; then draw off by distillation two gallons and a half of liquor.

This was considered formerly as a useful nervous medicine.

AQUA VALERIANÆ COMPOSITA.

Edinb.

*Compound Valerian Water.*

Take of

- Wild valerian root, a pound and a half;
- Lovage seed, half a pound;
- Pennyroyal leaves, four ounces;
- Savin tops, two ounces;
- French brandy, two gallons.

Digest for two days, and then draw off by distillation two gallons.

AQUA SEMINUM CARDAMOMI.

Lond

*Cardamom Seed Water.*

Take of

- Letlier cardamom seeds, freed from the husks, four ounces;
- Proof-spirit, one gallon;
- Water, as much as is sufficient to prevent burning.

Distil off one gallon.

This is a grateful aromatic cordial.

AQUA SEMINUM CARUI.

Lond

*Caraway Water.*

Take of

- Caraway seeds, half a pound;
- Proof-spirit, one gallon;
- Water, as much as will prevent burning.

Distil off one gallon.

This is a common cordial of the shops.

AQUA CINNAMONI SPIRITUOSA.

Lond.

*Spirituous Cinnamon Water.*

Take of

- Cinnamon, a pound;
- Proof-spirit, a gallon;
- Water, so much as will prevent burning.

Draw off by distillation one gallon.

The spirit is reckoned more agreeable, and possessing more of the real flavor by adding to the aqua cinnamomi simplex an equal part of proof-spirit.

AQUA JUNIPERI COMPOSITA.

Lond.

*Compound Juniper Water.*

Take of

- Juniper berries, one pound;
- Sweet fennel seeds,
- Caraway seeds, each an ounce and a half;

Proof-spirit, one gallon;  
 Water, as much as is sufficient to prevent burning;  
 Distil off one gallon.

*Edinb.*

Take of

Juniper berries, well bruised, one pound;  
 Seeds of caraway,  
     sweet fennel, of each an ounce and a half;

Proof-spirit, nine pounds.

Macerate two days; and having added as much water as will prevent an empyreuma, draw off by distillation nine pounds.

This spirit is chiefly to be used in cases of dropsy from simple debility, without any fixed obstruction.

**AQUA MENTHÆ PIPERITIDIS SPIRITUOSA.**

*Lond.*

*Spirituus Peppermint Water.*

Take of

Peppermint leaves, dry, a pound and a half;  
 Proof-spirit, a gallon;

Water, as much as is sufficient to prevent an empyreuma.

Draw off by distillation one gallon.

This preparation is much employed in flatulent cases, and is more proper than the water in violent spasms from this cause.

**AQUA MENTHÆ VULGARIS SPIRITUOSA.**

*Lond.*

*Spirituus Spearmint Water.*

Take of

Spearmint leaves, dry, a pound and a half;

Proof-spirit, a gallon;

Water, as much as will prevent burning.

Distil off one gallon.

This is a useful medicine in chronic weakness of stomach attended with reaching, given in the dose of half an ounce, diluted in any aqueous liquor.

**AQUA MIRABILIS.**

Take of

Cinnamon, two ounces;

Lemon-peel, one ounce;

Angelica seeds,

Lesser cardamom seeds,

Mace, each half an ounce;

Cubeb, two drams;

Balm leaves six ounces;

French brandy, one gallon.

our the brandy on the other ingredients bruised: and after digesting them for four days, draw off by distillation one gallon.

**AQUA AROMATICA, vulgo MIRABILIS.**

*Edinb.*

*Aromatic Water, commonly called Aqua Mirabilis.*

Take of

Cinnamon, two ounces;  
Fresh yellow rind of lemons,  
Angelica seeds, each one ounce;  
Mace, half an ounce;  
Peppermint, three ounces;  
French brandy, one gallon.

Let it stand for two days, and then distil off one gallon.

**AQUA PIPERIS JAMAICENSIS SPIRITUOSA.**

*Spirituus Jamaica Pepper Water.*

Take of

Jamaica pepper, half a pound;  
Proof-spirit, three gallons;  
Water, a sufficient quantity to prevent an empyreuma.

Draw off by distillation three gallons.

These three waters are all warm cordials, and agree in their general qualities.

**AQUA NUCIS MOSCHATÆ.**

*Lond.*

*Nutmeg Water:*

Take of

Nutmegs, two ounces;  
Proof-spirit, a gallon;  
Water, as much as will prevent burning.

Draw off by distillation one gallon.

This is a warm cordial prepared by the distiller, and is used oftener as a cordial than a medicine.

**AQUA POEONIÆ COMPOSITA.**

*Compound Peony Water.*

Take of

Peony roots, two ounces;  
Wild valerian roots, an ounce and a half;  
White dittany root, one ounce;  
Peony seeds, six drams;  
Lilies of the vallies, fresh, four ounces;  
Lavender flowers,  
Rosemary flowers, each two ounces;  
Betony,  
Marjoram,  
Rue,  
Sage, tops of each, one ounce;

French brandy, a gallon and a half.

Cut or bruise those materials that require such treatment, steep them four days in the brandy, and then distil over a gallon and a half of liquor.

This was formerly esteemed in epilepsy.

#### AQUA PULEGII SPIRITUOSA.

*Lond.*

*Spiritous Penny-royal Water.*

Take of

Penny-royal leaves, dry, a pound and a half;

Proof-spirit, a gallon;

Water, as much as will prevent burning.

Distil off one gallon.

Spirit of penny-royal is a good deal employed as a carminative and antihyteric medicine.

#### AQUA RAPHANI COMPOSITA.

*Lond.*

*Compound Horseradish Water.*

Take of

Garden scurvygrass leaves, fresh, four pounds;

Horseradish root, fresh,

Orange peel, fresh, each two pounds;

Nutmegs, nine ounces;

Proof-spirit, two gallons;

Water, sufficient quantity to prevent burning.

Draw off by distillation two gallons.

*Edinb.*

Take of

Horseradish root,

Garden scurvygrass, fresh, each three pounds;

Orange peel, fresh,

Juniper berries,

Canella alba, each four ounces;

French brandy, three gallons.

Steep the juniper berries and canella alba in the spirit for two days; then draw off three gallons.

This is an elegant spirit, though somewhat disagreeable in the flavour. It is used as a powerful antiscorbutic, though we should very much doubt its efficacy in this respect.

#### AQUA VULNERARIA, seu AQUA CATAPULTARUM.

*Pharm. Argent.*

*Arquebuse Water.*

Take of

Comfrey, leaves and root,

Sage,

Mugwort,

Ruglofs, each four handfuls ;  
 Be ony,  
 Sanicle,  
 Ox-eye daify,  
 Common daify,  
 Greater figwort,  
 Plantane,  
 Agrimony,  
 Veivain,  
 Wormwood,  
 Fennel, each two handfuls ;  
 St. John's wort,  
 Long birthwort,  
 Orpion,  
 Veronica,  
 Lefler centaury,  
 Miltoil,  
 Tobacco,  
 Moufe-ear,  
 Mint,  
 Hyffop, each one handful ;  
 Wine, twenty-four pounds.

Having cut and bruifed the herbs, pour on them the wine, and let them ftand together in digeftion, in horfedung, or other equivalent heat, for three days : afterwards diftil in an alembic, with a moderate fire.

This celebrated water is chiefly againft external wounds and ulcers.

### CLASS III. *Inflammables.*

#### FLORES SULPHURIS LOTI.

*Lond.*

*Wafhed Flowers of Sulphur.*

Take of

Flowers of fulphur, one pound ;  
 Diftilled water, four pints

Boil the flowers of fulphur a little while in the diftilled water ; then pour off this water, and wafh of the acid with cold water ; laftly, dry the flowers

The wafhing of the fulphur is here directed for the purpofe of freeing it of any fuperfluous acid acquired in their preparation, and which is apt to irritate the bowels when ufed as a medicine.

#### KALI SULPHURATUM.

*Lond.*

*Sulphurated Kali.*

Take of

Flowers of fulphur, one ounce ;  
 Potafh five ounces,

Mix the salt with the melted sulphur, by frequently stirring, until they unite in an uniform mass.

In this preparation part of the sulphur is dissipated. It possesses, as a medicine, a foetid smell and nauseous taste. It has been used in natural complaints in the form of syrup, though now exploded. It is also applied to cutaneous diseases, as herpes and psora, particularly in the form of ointment, and as a wash in cutaneous diseases. It forms a powerful antidote to mercurial poisons. It imparts a rich colour digested in alcohol.

**OLEUM SULPHURATUM et PETROLEUM SULPHURATUM.**

*Lond.*

*Sulphurated Oil and Sulphurated Petroleum.*

Take of

Flowers of sulphur, four ounces;

Olive oil, sixteen ounces.

Boil the flowers of brimstone, with the oil, in a pot slightly covered, until they be united.

In the same manner is made sulphurated petroleum.

These articles stand in place of the former sulphurated balsams, and the latter may be made by adding to the present preparation so much of any of the essential oils as gives it a sufficient impregnation. Though formerly much recommended in pectoral complaints, they are now entirely out of repute. The dose of the simple preparation is from 10 to 40 drops of the balsam; that of the compound less. Their external use to foul gleans and ulcerations form their most frequent mode of application.

**SULPHUR PRECIPITATUM.**

*Lond.*

*Precipitated Sulphur.*

Take of

Sulphurated kali, six ounces;

Distilled water, one pound and a half;

Vitriolic acid, diluted, as much as is sufficient.

Boil the sulphurated kali in the distilled water until it be dissolved.

Filter the liquor through paper, to which add the vitriolic acid.

Wash the precipitated powder by often pouring on water till it becomes insipid.

This preparation differs only in colour from the pure sulphur. From this colour its solution has been termed **Lac Sulphuris.**

*Essential Oils.*

Essential oils are only the product of odorous substances, and the quantity procured from different articles of this class cannot be previously determined from the apparent sensible qualities of the substance, and it is very much influenced by the soil and season in the same substance in a considerable degree. Thus dry soil and warm summers are the most favourable to procuring much of this product, and a moderate exsiccation of the substance will also facilitate its extrication.

In directing the distillation various circumstances require attention.

1. The first, is the quantity of water to be used, which must be here regulated by that of the material. Thus when the half of the cavity of the vessel is filled with the substance, as much water should be added as may occupy two thirds in height.

2. The next circumstance is the maceration of the substance, so that the fluid may penetrate every part of it; and in order to this taking place, the substance should be reduced, if wood, to coarse powder; if seeds, slightly bruised; and the time allotted for this operation, according to the texture of the substance, should be from a week or two to the same number of days.

3. The third circumstance is the addition of a slight ferment for a few days, with half their quantity of water.

4. The fourth is accommodating the instrument of distillation to the nature of the substance: thus, some substances do best with the common still; others require a large low head, having a rim or canal round it, to detain the oil in its first ascent.

5. In the management of the heat it should be raised quickly to keep the water strongly boiling, though the degree of heat is somewhat regulated by the nature of the substance, as some substances require less of it than others. In the former case the products are termed ponderous oils, in the latter, light oils; and to preserve their fragrance, the substance which gives out the latter, is not im-



mersed in the water of the still, but suspended immediately above it in a basket.

6. The water which comes over in distillation should be employed a second time for the same purpose, and not, that tainted with empyreuma which remains in the still.

7. In distilling different oils cleanliness should be observed, that no impregnation may be received from each other.

8. After distillation the oils should be allowed to stand uncovered till they lose their fiery odour, and then corked close till used.

9. The qualities of essentials oils, when lost, may be restored in the manner formerly pointed out, p. 126.

10. Essential oils agree only in two general circumstances, their pungency and heat. They differ in their individual qualities, according to the nature of the substance from which they are taken.

11. The degree of their pungency and heat cannot also be judged of *a priori* from the sensible qualities of the subject from which they are taken.

12. In medicine essential oils are chiefly employed as correctors of disagreeable medicines, particularly in their junction with resinous purgatives, so as to make them sit easy on the stomach.

13. Essential oils are exhibited by triture with sugar, which renders them soluble in syrups and mucilaginous liquors, and in this form they are prescribed.

Their general effects as medicines are, when pungent, powerful stimulants in palsy and chronic rheumatism, and in local affections of pain or swelling, where there is no active inflammation.

#### OLEUM ABSINTHII ESSENTIALE.

L. E.

*Essential Oil of the Leaves of Wormwood.*

This oil is recommended as a mild anodyne, dissolved in spirit of wine in the proportion of a dram to the ounce, and seven or eight drops forming a dose: externally, it is chiefly employed as a vermifuge.

OLEUM SEMINUM ANETHI ESSENTIALE.

*Lond.*

*Essential Oil of Dill Seeds.*

Is useful in flatulence and cholick from one to four drops.

OLEUM SEMINUM ANISI ESSENTIALE.

*L. E.*

*Essential Oil of Aniseed.*

It is superior to the former for the same purpose, and may be taken in fifteen or twenty drops.

OLEUM SEMINUM CARUI ESSENTIALE.

*L. E.*

*Essential Oil of Caraway Seeds.*

Is a powerful carminative and diuretic. Three drops are a dose.

OLEUM CARYOPHYLLORUM AROMATICORUM ESSENTIALE.

*L. E.*

*Essential Oil of Cloves.*

The genuine oil of cloves is mild, and may be safely taken diluted to ten or twelve drops, as a stomachic and stimulant.

OLEUM FLORUM CHAMÆMELI ESSENTIALE.

*Lond.*

*Essential Oil of Chamomile Flowers.*

Is given in nervous cases in a few drops, and is also used as a vermifuge.

OLEUM CINNAMOMI.

*L. E.*

*Oil of Cinnamon.*

Is a powerful nervous medicine and restorative, in doses of two or three drops.

OLEUM SEMINUM CYMINI ESSENTIALE.

*Lond.*

*Essential Oil of Cummin Seeds.*

This is employed in nervous cases in a dose of two or three drops, being reckoned also diuretic.

OLEUM SEMINUM FENICULI ESSENTIALE.

*Edinb.*

*Essential Oil of Fennel.*

It is a useful carminative, given in doses from two or three to twelve drops.

## OLEUM BACCARUM JUNIPERI ESSENTIALE.

L. E.

*Essential Oil of Juniper Berries.*

Is more stimulant than the former, but given in the same cases.

## OLEUM FLORUM LAVENDULÆ ESSENTIALE.

L. E.

*Essential Oil of Lavender Flowers.*

Is a medicine of great worth externally and internally in all affections of the nervous system. The dose from one drop to five or six.

## ESSENTIA LIMONUM.

[L.]

## OLEUM CORTICUM.

[L.]

*Essence of Lemons, or the Essential Oil of Lemon Peel.*

It is a pleasant cordial and perfume, and used in the preparation of other medicines.

## OLEUM MAJORANÆ ESSENTIALE.

Lond.

*Essential Oil of Marjoram Leaves.*

This oil is supposed to possess a specific action in uterine diseases attended with relaxation, and it is given in a dose of one or two drops.

## OLEUM MENTHÆ ESSENTIALE.

L. E.

*Essential Oil of the Leaves of common Mint.*

Is a useful stomachic medicine in weakness of the organ, in a dose of two or three drops.

## OLEUM MENTHÆ PIPERITIDIS ESSENTIALE.

L. E.

*Essential Oils of the Leaves of Peppermint.*

This oil is the most useful of all carminatives, in the dose of a drop or two.

## OLEUM NUCIS MOSCHATÆ ESSENTIALE.

L. E.

*Essential Oil of Nutmegs.*

Possesses all the flavor and aromatic virtues of the spice for which it is used.

OLEUM ORIGANI ESSENTIALE.

*L. E.*

*Essential Oil of the Leaves of Origanum*

This oil is chiefly as a caustic, and for tooth-ach.

OLEUM ESSENTIALE PIPERIS JAMAICENSIS.

*Edib.*

*Essential Oil of Jamaica Pepper.*

This oil is cheaper than that of nutmegs, and used for the same purpose.

OLEUM PULFEGII ESSENTIALE.

*F. amb.*

*Essential Oil of Penny-Royal.*

This oil is used in hysteric cases, in a dose of one to five drops.

OLEUM ROSMARINI ESSENTIALE.

*L. E.*

*Essential Oil of Rosemary.*

It is very fragrant, and recommended in nervous complaints in the dose of a few drops.

OLEUM LIGNII ESSENTIALE.

*L. E.*

*Essential Oil of Rhodium.*

This is used principally, from its odoriferous quality, as a perfume.

OLEUM RUTÆ ESSENTIALE.

*L. E.*

*Essential Oil of Rue Leaves.*

Is a powerful anti hysteric and emmenagogue.

OLEUM SABINÆ ESSENTIALE.

*L. E.*

*Essential Oil of Savin Leaves.*

Possesses the same qualities as the former, in a dose of two or three drops.

OLEUM SASSAFRASS ESSENTIALE.

*L. E.*

*Essential Oil of Sassafras*

Is a powerful sudorific and alterative, given from one drop to eight for a dose.

## OLEUM TEREBINTHINÆ.

*Lond. Edin.**Oil of Turpentine.*

This is a hot stimulating medicine, and given as a sudorific and diuretic, in two or three drops. In larger doses it excites perspiration, and is given with honey in sciatica; externally, it is applied in chronic rheumatism, swellings of various kinds, and passive hemorrhages.

CLASS IV. *Salts.*

## ACIDUM VITRIOLICUM DILUTUM.

*Lond.**Diluted Vitriolic Acid.*

Take of

Vitriolic acid, one ounce by weight;

Distilled water, eight ounces by weight.

Mix them by degrees.

ACIDUM VITRIOLICUM DILUTUM, *vulgo* SPIRITUS VITRIOLI TENUIS.*Edin.**Diluted Vitriolic Acid, commonly called Weak Spirit of Vitriol.*

Take of

Vitriolic acid, one part;

Water, seven parts.

Mix them.

## ACIDUM NITROSUM.

*Lond.**Nitrous Acid.*

Take of

Purified nitre, sixty ounces;

Vitriolic acid, by weight, twenty-nine ounces.

Mix and distil.

The specific gravity of this acid is to that of distilled water as 1,550 to 1,000.

ACIDUM NITROSUM, *vulgo* SPIRITUS NITRI.*Edn.**Nitrous Acid, commonly called Spirit of Nitre.*

Take of

Purest nitre, bruised, two pounds;

Vitriolic acid, one pound.

Having put the nitre into a glass retort, pour on it the acid; then distil in a sand-heat, gradually increasing the fire till the sand-pot becomes of a dull red colour.

The specific gravity of it to that of water ought to be as 1,550 to 1,000.

It has been given, diluted with any convenient vehicle, as a diuretic, in doses of from ten to fifty drops.

ACIDUM NITROSUM DILUTUM.

*Lond. Edinb.*

*Diluted Nitrous Acid.*

Take of

Nitrous acid,

Distilled water, each equal weights.

Mix them, taking care to avoid the noxious vapours.

ACIDUM MURIATICUM.

*Lond.*

*Muriatic Acid.*

Take of

Dry sea-salt, ten pounds;

Vitriolic acid, by weight six pounds;

Water, by weight, five pounds.

Add the vitriolic acid, first mixed by degrees with the water, to the salt; then distil.

The specific gravity of this acid is to that of distilled water as 1,170 to 1,000.

ACIDUM MURIATICUM, *vulgo* SPIRITUS SALINIS MARINI.

*Edin.*

*Muriatic Acid, commonly called Spirit of Sea-Salt.*

Take of

Sea-salt, two pounds;

Vitriolic acid,

Water, each one pound.

Let the salt be first put into a pot, and brought to a red heat, that the oily impurities may be consumed; then put it into the retort; next mix the acid with the water, and when the mixture has cooled, pour it upon the salt. Lastly, distil in a sand bath, with a middling heat, as long as any acid comes over.

The specific gravity of this acid is to that of water as 1,170 to 1,000.

It is used chiefly as a menstruum for the making of other preparations; sometimes, likewise, it is given, properly diluted, as an antiphlogistic, aperient, and diuretic, in doses of from ten to sixty or seventy drops.

## ACETUM DISTILLATUM.

*Lord.**Distilled Vinegar.*

Take of

Vinegar five pints.

Distil over a fire, in glass vessels, so long as the drops fall free from empyreuma.

*Edin.*

Let eight pounds of vinegar be distilled in glass vessels with a gentle heat. Let the two first pounds that come over be thrown away, as containing too much water; let the four pounds next following be reserved as the distilled vinegar. What remains is a still stronger acid, but being too much burnt is unfit for use.

Their principal difference from the mineral acids consists in their being milder, less stimulating, less disposed to affect the kidneys and promote the urinary secretions, or to coagulate the animal juices. The matter left after the distillation in glass vessels, though not used internally, would doubtless prove a serviceable detergent.

## ACETUM CONCENTRATUM.

*Sars.**Concentrated Vinegar.*

Let white wine vinegar be frozen in a wooden vessel in cold winter weather; and let the fluid separated from the ice be preserved for use. It may be considered as sufficiently strong, if one drachm of it be capable of saturating a scruple of the fixed vegetable alkali.

## ACIDUM ACETOSUM.

*Lord.**Acetic Acid.*

Take of

Verdigris, in coarse powder, two pounds

Put it perfectly by means of a water-bath furnished with sea salt; then

distil it in a sand-bath, and distil the liquor a long time

Its specific gravity is to that of distilled water as 1,050 to 1,000.

## ACIDUM TARTARI CRYSTALLIZATUM.

*Sars.**Crystallized Acid of Tartar.*

Take of

Prepared chalk, frequently washed with warm water, two pounds;

Spring water, thirty-two pounds

Let it boil gently, by degree add of cream of tartar seven pounds,

as much as is sufficient for saturation. Removing the vessel

from the fire, let it stand for half an hour, then cautiously pour off the clear liquor into a glass vessel. Wash the residuum of tartareous selenites by pouring water on it three or four times. To this residuum afterwards add of weak vitriolic acid (consisting of one part of strong acid, and eight of water,) fifteen pounds: let it be digested for a day, frequently stirring it with a wooden spatula. After this pour the acid liquor into a glass vessel: but with the residuum mix sixteen pounds of spring water: strain it through paper, and again pour water on the residuum till it become insipid. Let the acid liquors mixed together in a glass vessel, be boiled to the consistence of a thin syrup; which being strained, must be put into earthen vessels, and evaporated in a sand-heat, till the acid concretes into slender crystals; observing to break, every two hours, the saline pellicle formed on the surface of the liquor during the evaporation. The crystals being at length fully dried, must be kept in a well stopped glass phial.

If before crystallization a little of the insipidated acid liquor be diluted with four times its quantity of pure water, and a few drops of acetated lead be put into it, a white sediment will immediately be deposited. If a few drops of the diluted nitrous acid be then added, the mixture will become limpid if the tartareous liquor be pure and entirely free from the vitriolic acid; but if it be not, it will remain white. This fault, however, may be corrected, if the acid of tartar be diluted with six pounds of water, and a few ounces of the tartareous selenite be added to it. After this it may be digested, strained, and crystallized.

#### ACIDUM TARTARI DISTILLATUM.

##### *Distilled Acid of Tartar.*

Let pounded crude tartar be put into a tabulated earthen or iron retort till it fills about two thirds of it, and let distillation be performed by gradually increasing the heat. Into the receiver, which should be very large, an acid liquor will pass over together with the oil; which being separated from the oil, must again be distilled from a glass retort.

If the residuum contained in the earthen or iron retort be diluted with water, strained through paper and boiled to dryness, it gives what is called the alkali of tartar. If this do not appear white, it may be made so by burning, solution, straining, and evaporation.

#### AQUA AERIS FIXI.

##### *R. J.*

##### *Acetated Water.*

Let spring water be saturated with the fixed air, or aerial acid, arising from a solution of chalk in vitriolic acid, or in any similar acid.



Water may be also impregnated by the fixed air rising from fermenting liquors.

Water properly impregnated with the aerial acid has an agreeable, acidulous taste. It is often employed with great advantage in the way of common drink, by those who are subject to stomach complaints, and by calculous patients. But, besides this, it furnishes an excellent vehicle for the exhibition of many other medicines.

#### AQUA ALKALINA AERATA.

*Aerated Alkaline Water.*

Let a solution of two ounces of vegetable alkali, in a gallon of water, be saturated with fixed air.

This aerated alkaline water has been found very serviceable in calculous and gouty cases.

#### FLORES BENZOES.

*Lond.*

*Flowers of Benzoin.*

Take of

Benzoin, in powder, one pound.

Put it into an earthen pot, placed in sand; and, with a slow fire, sublime the flowers into a paper cone fitted to the pot.

If the flowers be of a yellow colour, mix them with white clay, and sublime them a second time.

#### ACIDUM BENZOINICUM, *vulgo* FLORES BENZOINI.

*Edin.*

*Benzoinic Acid, commonly called Flowers of Benzoin.*

Put any quantity of powdered benzoin into an earthen pot, to which, after fitting it with a large conical paper cap, apply a gentle heat, that the flowers may sublime. If the flowers be impregnated with oil, let them be purified by solution in warm water and crystallization.

#### SAL BENZOES.

*Succ.*

*Salt of Benzoin.*

Take of

Benzoin, in fine powder,

Quicklime powder, each half a pound;

Water, four pounds.

Boil them gently for a quarter of an hour, and filter the liquor, while warm, through paper. Add to the residuum four pounds more of water. Boil and filter this liquor as the former: Mix these and boil

them in a tin vessel down to two pounds. When cold, pour it into a glass vessel, and drop into it some muriatic acid as long as any precipitate is formed. After standing a while, pour off the clear liquor; wash the precipitate with cold water, and dry it on filtering paper.

These flowers, when made in perfection, have an agreeable taste and fragrant smell. They totally dissolve in spirit of wine; and likewise, by the assistance of heat, in water. By the mediation of sugar they remain suspended in cold water, and thus form an elegant balsamic syrup. Some have held them in great esteem as pectoral and sudorific, in the dose of half a scruple or more: but at present they are rarely used, on account of the offensive oil with which, as usually prepared, they are tainted.

They enter the composition of the peregoric elixir, or *tinctura spiritus camphorata*, as it is now called.

LIXIVA E TARTARO, *vulgo* SAL TARTARI.

*Ed'n.*

*Lixive of Tartar, commonly called Salt of Tartar.*

Take of

Tartar, what quantity you please.

Roll it up in a piece of moist bibulous paper, or put it into a crucible, and burn it to a coal; next, having beat this coal, calcine it in an open crucible with a moderate heat, taking care that it do not smelt, and continue the calcination till the coal becomes of a white, or at least of an ash colour; then dissolve it in warm water; strain the liquor through a cloth, and evaporate it in a clean iron vessel; diligently stirring it towards the end of the process with an iron spatula, to prevent it from sticking to the bottom of the vessel. A very white salt will remain, which is to be left a little longer on the fire, till the bottom of the vessel becomes almost red. Lastly, when the salt is grown cold, let it be put up in glass vessels well stopp'd.

KALI PRÆPARATUM.

*Lond.*

*Prepared Kali.*

Take of

Pot-ash, two pounds;

Boiling distilled water, three pints.

Dissolve and filter through paper; evaporate the liquor till a pellicle appears on the surface; then set it aside for 12 hours that the neutral salts may crystallize; after which pour out the liquor, and

boil away the whole of the water, constantly stirring, lest any salt should adhere to the pot.

In like manner is purified impure kali from the ashes of any kind of vegetable.

The same salt may be prepared from tartar burnt till it becomes of an ash colour.

**LIXIVA PURIFICATA, vulgo SAL ALKALINUS FIXUS  
VEGETABILIS PURIFICATUS.**

*Edin.*

*Purified Lixive, commonly called Purified Fixed Vegetable Alkaline Salt.*

Let the fixed alkaline salt, called in English pearl-ashes, be put into a crucible, and brought to a somewhat red heat, that the oily impurities, if there be any, may be consumed: then having powdered it, agitate it with an equal weight of water, that they may be well mixed. After the pieces have subsided, pour the ley into a very clean iron pot, and boil to dryness, stirring the salt towards the end of the process, to prevent its sticking to the vessel.

If this salt has been rightly purified, though it be very dry it may be dissolved into a liquor void of colour or smell, by rubbing it with an equal weight of oil r.

The purified vegetable alkali is frequently employed in medicine, in conjunction with other articles: particularly for the formation of saline neutral draughts and mixtures: but it is used also by itself in doses of from three or four grains to fifteen or twenty; and it frequently operates as a powerful diuretic, particularly when aided by proper dilution and a warm regimen.

**AQUA KALI PRÆPARATI.**

*Lond.*

*Water of Prepared Kali.*

Take of

Prepared kali, one pound.

Set it by in a moist place till it be dissolved, and then strain it

**AQUA KALI PURI.**

*Lond.*

*Water of Pure Kali.*

Take of

Prepared kali, four pounds;

Quick lime, six pounds;

Distilled water, four gallons.

Put four pints of water to the lime, and let them stand together for an hour; after which, add the kali and the rest of the water; then boil for a quarter of an hour; suffer the liquor to cool, and strain it. A pint of this liquor ought to weigh sixteen ounces. If the liquor effervesces with any acid, add more lime, and boil the liquor for five minutes, after which strain it.

**AQUA LIXIVIA CAUSTICA, *vulgo* LIXIVIUM CAUSTICUM.**

*Edin.*

*Caustic Ley.*

Take of

Fresh burnt quicklime, eight ounces;  
Purified l xive, six ounces.

Throw the quicklime into an iron or earthen vessel, with twenty-eight ounces of warm water. The chullition and extinction of the lime being perfectly finished, instantly add the alkaline salt; and having thoroughly mixed them, cover the vessel till it be cool. Stir the cooled matter, and pour out the whole into a glass funnel, whose throat must be stopped up with a piece of clean rag. Let the upper mouth of the funnel be covered, while the tube of it is inserted into a glass vessel, so that the ley may gradually drop through the rag into that vessel. When it first gives over dropping, pour into the funnel some ounces of water, but cautiously; so that the water may swim above the matter. The ley will again begin to drop, and the effusion of water is to be repeated in the same manner, until three pounds have dropped, which takes up the space of two or three days; then agitating the superior and inferior parts of the ley together, mix them, and put them up in a well stop'd phial.

If the ley be rightly prepared, it will be void of colour or smell; nor will it raise an effervescence with acids, except, perhaps, a very slight one. Colour and odour denote the salt not sufficiently calcined; and effervescence, that the quicklime has not been good.

The caustic ley, under various pompous names, has been much used as a lithontriptic; but its fame is now beginning to decline. In acidities in the stomach, attended with much flatulence and laxity, the caustic ley is better adapted than mild alkalies; as in its union with the acid matter it does not separate air. When covered with mucilaginous matters, it may be safely taken into the stomach; and by stimulating it, coincides with the other intentions of cure. It has been employed with advantage in dyspeptic cases.

## KALI PURUM.

*Lond.**Pure Kali.***Take of**

Water of pure kali, one gallon.

Evaporate it to dryness; after which let the salt melt on the fire, and pour it out.

## CAUSTICUM COMMUNE ACERRIMUM.

*Edn.**The strongest Common Caustic.***Take of**

Caustic ley, what quantity you please.

Evaporate it in a very clean iron vessel on a gentle fire, till, on the ebullition ceasing, the saline matter gently flows like oil, which happens before the vessel becomes red. Pour out the caustic, thus liquified, on a smooth iron plate: let it be divided into small pieces before it hardens, which are to be kept in a well stoppt phial.

The caustic prepared in this way has an inconvenience of being apt to liquefy too much on the part to which it is applied, so that it is not easily confined within the limits in which it is intended to operate; and indeed the suddenness of its action depends on this disposition to liquefy.

## CALX CUM KALI PURO.

*Lond.**Mix with Pure Kali.***Take of**

Quicklime, five pounds and four ounces;

Water of pure kali, sixteen pounds by weight.

Boil away the water of pure kali to a fourth part; then sprinkle in the lime, reduced to powder by the affusion of water. Keep it in a vessel close stoppt.

## CAUSTICUM COMMUNE MITIUS.

*Edin.**The milder Common Caustic.***Take of**

Caustic ley, what quantity you please.

Evaporate it in an iron vessel till one-third remains; then mix with it as much new-baked quicklime as will bring it to the consistence of pretty solid pap, which is to be kept in a vessel closely stoppt.

NATRON PRÆPARATUM.

*Lord.*

*Prepared Natron.*

Take of

Barilla, powdered, two pounds;

Distilled water, one gallon.

Boil the barilla in four pints of water for half an hour, and strain.

Boil the residuum with the rest of the water, and strain. Evaporate the mixed liquors to two pints, and set them by for eight days; strain this liquor again; and after due boiling, set it aside to crystallize. Dissolve the crystals in distilled water; strain the solution, boil, and set it aside to crystallize.

SODA PURIFICATA, *vulgo* SAL ALKALINUS FIXUS  
FOSSILIS PURIFICATUS.

*Edin.*

*Purified Soda, commonly called Purified Fixed Fossil Alkaline Salt.*

Take of

Ashes of Spanish kali, or barilla, as much as you please.

Bruise them; then boil in water till all the salt be dissolved. Strain this through paper, and evaporate it in an iron vessel, so that after the liquor has cooled the salt may concrete into crystals.

The fossil alkali is not only a constituent of different neutrals, but it is also sometimes employed as a medicine by itself. And in its purified state it has been by some reckoned useful in affections of the scrophulous kind.

AMMONIA PRÆPARATA.

*Lord.*

*Prepared Ammonia.*

Take of

Sal ammoniac, powdered, one pound;

Prepared chalk, two pounds.

Mix and sublime.

AMMONIA PRÆPARATA, *vulgo* SAL AMMONIACUS  
VOLATILIS.

*Edin.*

*Prepared Ammonia, commonly called Volatile Sal Ammoniac.*

Take of

Sal ammoniac, one pound;

Chalk, very pure and dry, two pounds.

Mix them well, and sublime from a retort into a refrigerated receiver.

## PHARMACY.

## AQUA AMMONIÆ.

Lond.

*Water of Ammonia.*

Take of

- Sal ammoniac, one pound ;
- Pot-ash, one pound and a half ;
- Water, four pints.

Draw off two pints by distillation, with a slow fire.

AQUA AMMONIÆ, *vulgo* SPIRITUS SALIS  
AMMONIACI.

Edin.

*Water of Ammonia, commonly called Spirit of Sal Ammoniac.*

Take of

- Sal ammoniac,
- Purified lixive, of each sixteen ounces ;
- Water, two pounds.

Having mixed the salts, and put them into a glass retort, pour in the water ; then distil to dryness with a sand-bath, gradually raising the heat.

## AQUA AMMONIÆ PURÆ.

Lond.

*Water of Pure Ammonia.*

Take of

- Sal ammoniac, one pound ;
- Quicklime, two pounds ;
- Water, one gallon.

Add to the lime two pints of the water. Let them stand together an hour ; then add the sal ammoniac and the other six pints of water boiling, and immediately cover the vessel. Pour out the liquor when cold, and distil off, with a slow fire, one pint.

AQUA AMMONIÆ CAUSTICÆ, *vulgo* SPIRITUS SALIS  
AMMONIACI CUM CALCE VIVÆ.

Edin.

*Water of Caustic Ammonia, commonly called Spirit of Sal Ammoniac with Quicklime.*

Take of

- Quicklime, fresh burnt, two pounds ;
- Water, one pound.

Having put the water into an iron or stone-ware vessel, add the quicklime, previously beat ; cover the vessel for twenty-four hours ; when the lime has fallen into a fine powder, put it into the retort ; then add sixteen ounces of sal ammoniac, dissolved in five pounds of water ; and, shutting the mouth of the retort, mix them together by agi-

tation. Lastly, distil into a refrigerated receiver with a very gentle heat, (so that the operator's hand can easily bear the heat of the retort) till twenty ounces of liquor are drawn off. In this distillation the vessels are to be so luted as to effectually restrain the vapours, which are very penetrating.

**LIQUOR VOLATILIS, SAL, ET OLEUM CORNU CERVI.**

*Lond.*

*The Volatile Liquor, Salt, and Oil, of Hartshorn.*

Take of

Hartshorn, ten pounds.

Distil with a fire gradually increased. A volatile liquor, salt, and oil will ascend.

The oil and salt being separated, distil the liquor three times.

To the salt add an equal weight of prepared chalk, and sublime thrice, or till it become white.

The same volatile liquor, salt, and oil, may be obtained from any parts (except the fat) of all kinds of animals.

**KALI VITRIOLATUM.**

*Lond.*

*Vitriolated Kali.*

Take of

The salt which remains after the distillation of the nitrous acid, two pounds.

Distilled water, two gallons.

Burn out the superfluous acid, with a strong fire, in an open vessel; then boil it a little while in the water; strain, and set the liquor aside to crystallize.

**LIXIVA VITRIOLATA, vulgo TARTARUM VITRIOLATUM.**

*Edin.*

*Vitriolated Lixive, commonly called Vitriolated Tartar.*

Take of

Vitriolated acid, diluted with six times its weight of water, as much as you please.

Put it into a capacious glass vessel, and gradually drop into it, of purified lixive, diluted with six times its weight of water, as much as is sufficient thoroughly to neutralize the acid. The effervescence being finished, strain the liquor through paper: and after proper evaporation, set it aside to crystallize.

Vitriolated tartar, in small doses, as a scruple or half a drachm, is an useful aperient; in large ones, as four or five drachms, a mild cathartic, which does not pass off



so hastily as the *magnesia vitriolata*, or *soda vitriolata*, and seems to possess a more extended action.

LIXIVIA VITRIOLATA SULPHUREA, *vulgo* *SAL*  
POLYCHRESTUS.

*Edin.*

*Sulphureous Vitriolated Lixive*, commonly called *Salt of many Virtues*.

Take of

Nitre in powder,

Flowers of sulphur, of each equal parts.

Mix them well together, and inject the mixture, by little and little at a time, into a red-hot crucible: the deflagration being over, let the salt cool, after which it is to be put up in a glass vessel well stopped. The salt may be purified by dissolving it in warm water, filtering the solution, and crystallizing it again.

NATRON VITRIOLATUM.

*Lond.*

*Vitriolated Natron.*

Take of

The salt which remains after the distillation of the muriatic acid, two pounds;

Distilled water, two pints and an half.

Burn out the superfluous acid with a strong fire, in an open vessel; then boil it for a little in the water; strain the solution, and set it aside to crystallize.

SODA VITRIOLATA, *vulgo* *SAL GLAUBERI*.

*Edin.*

*Vitriolated Soda*, commonly called *Glauber's Salts*.

Dissolve in warm water the mass which remains after the distillation of the muriatic acid; filter the solution, and crystallize the salt.

NITRUM PURIFICATUM.

*Lond.*

*Purified Nitre.*

Take of

Nitre, two pounds;

Distilled water, four pints.

Boil the nitre in the water till it be dissolved; strain the solution, and set it aside to crystallize.

KALI ACETUM.

*Lond.*

*Acetated Kali.*

Take of

Kali, one pound.

Boil it, with a slow fire, in four or five times its quantity of distilled vinegar: the effervescence ceasing, add, at different times, more distilled vinegar, until the last vinegar being nearly evaporated, the addition of fresh will excite no effervescence, which will happen when about twenty pounds of distilled vinegar are consumed: afterwards let it be dried slowly. An impure salt will be left, which melt for a little while with a slow fire; then let it be dissolved in water, and filtered through paper.

If the fusion has been rightly performed, the strained liquor will be colourless; if otherwise, of a brown colour.

Lastly, evaporate this liquor with a slow fire, in a very shallow glass vessel; frequently stirring the mass, that the salt may be more completely dried, which should be kept in a vessel close stopped.

The salt ought to be very white, and dissolve wholly, both in water and spirit of wine, without leaving any feces. If the salt, although white, should deposit any feces in spirit of wine, that solution in the spirit should be filtered through paper, and the salt again dried.

LIXIVA ACETATA, *vulgo* TARTARUM REGENERATUM.

*Edin.*

*Acetated Lixive, commonly called Regenerated Tartar.*

Take of

Purified lixive, one pound.

Boil it with a very gentle heat in four or five times its quantity of distilled vinegar; add more distilled vinegar, at different times, till on the watery part of the former quantity being nearly dissipated by evaporation, the new addition of vinegar ceases to raise any effervescence. This happens, when about twenty pounds of distilled vinegar has been consumed. The impure salt remaining after the exsiccation, is to be melted with a gentle heat, and kept fluid only for a short time; then dissolve it in water, and strain through paper. If the liquefaction has been properly performed, the strained liquor will be limpid; but if otherwise, of a brown colour.

Evaporate this liquor with a very gentle heat in a shallow glass vessel, occasionally stirring the salt as it becomes dry, that its moisture may sooner be dissipated. Then put it up into a vessel very closely stopp'd, to prevent it from liquefying in the air.

*Another Process.*

Dissolve a pound of salt of tartar in a sufficient quantity of cold water; filter the solution, and add by degrees as much distilled vinegar as will saturate it, or a little more. Set the liquor to evaporate in a stone-ware vessel in a gentle heat, not so strong as to make it boil. When a pellicle appears on the surface, the rest of the process must be finished in a water-bath. The liquor acquires, by degrees, an oily consistence and a pretty deep brown

colour; but the pellicle or scum on the top looks whitish, and when taken off and cooled, appears a congeries of little brilliant silver-like plates. The matter is to be kept constantly stirring, till it be wholly changed into this white flaky substance; the complete drying of which is most conveniently effected in a warm oven.

The *lixiva acetata*, which way soever prepared, provided it be properly made, is a medicine of great efficacy, and may be so dosed and managed as to prove either mildly cathartic, or powerfully diuretic: few of the saline deobstruents come up to it in virtue. The dose is from half a scruple to a drachm or two.

#### AQUA AMMONIÆ ACETATÆ.

*Lond.*

*Water of Acetated Ammonia.*

Take of

Ammonia, by weight, two ounces;

Distilled vinegar, four pints; or as much as is sufficient to saturate the ammonia.

Mix.

#### AQUA AMMONIÆ ACETATÆ, *vulgo* SPIRITUS MINDERERI.

*Edin.*

*Water of Acetated Ammonia, commonly called Spirit of Mindererus.*

Take any quantity of prepared ammonia, and gradually pour as much distilled vinegar on it as is sufficient to saturate it completely.

This is an excellent aperient saline liquor. Taken warm in bed, it generally proves a powerful diaphoretic or sudorific; and as it operates without heat, it has place in febrile and inflammatory disorders, where medicines of the warm kind, if they fail of procuring sweat, aggravate the distemper. Its action may likewise be determined to the kidneys, by walking about in a cool air. The common dose is half an ounce, either by itself, or along with other medicines adapted to the intention.

#### KALI TARTARISATUM.

*Lond.*

*Tartarified Kali.*

Take of

Prepared kali, one pound;

Crystals of tartar, three pounds;

Distilled water, boiling, one gallon.

To the kali, dissolved in the water, throw in gradually the crystals of tartar powdered; filter the liquor, when cold, through paper; and after due evaporation, set it apart to crystallize.

**LIXIVA TARTARISATA, vulgo TARTARUM SOLUBILE.**

*Edin.*

*Tartarified Lixive, commonly called Soluble Tartar.*

Take of

Purified lixive, one pound;

Water, fifteen pounds.

To the salt dissolved in the boiling-water gradually add crystals of tartar in fine powder, as long as any effervescence rises, which generally ceases before three times the weight of the alkaline salt hath been added; then strain the cooled liquor through paper, and after due evaporation set it aside to crystallize.

In doses of a scruple, half a drachm, or a drachm, this salt is a mild cooling aperient: two or three drachms commonly loosen the belly; and an ounce proves pretty strongly purgative. It has been particularly recommended as a purgative for maniacal and melancholic patients.

**NATRON TARTARISATUM.**

*Lond.*

*Tartarified Natron.*

Take of

Natron, twenty ounces;

Crystals of tartar, powdered, two pounds;

Distilled water, boiling, ten pints.

Dissolve the natron in the water, and gradually add the crystals of tartar; filter the liquor through paper; evaporate, and set it aside to crystallize.

**SODA TARTARISATA, vulgo SAL RUPELLENSIS.**

*Edin.*

*Tartarified Soda, commonly called Rochel Salt.*

The *Sal Rupellensis* may be prepared from purified soda and crystals of tartar, in the same manner as directed for the *Lixiva tartarificata*.

It is considerably less purgative than the preceding preparation, but is equally decomposed by acids. It appears to be a very elegant salt, and is in great esteem in this country.

## SODA PHOSPHORATA.

*Edin.**Phosphorated Soda.***Take of**

Bones burnt to white ashes and powdered, ten pounds ;

Vitriolic acid, six pounds ;

Water, nine pounds.

Mix the powder and acid together in an earthen vessel ; then add the water, and stir the whole so as to mix it thoroughly. Place the vessel in a vapour bath, and digest for three days ; after which dilute the mass with nine pounds more of boiling water, and strain the liquor through a strong linen cloth, adding at the end some more warm water, that all the acidity may be well washed out. Set by the strained liquor that the impurities may subside, and decant the clear solution. Evaporate it till only nine pounds remain, and let it stand till the impurities subside. This second liquor poured from the impurities must be evaporated again till seven pounds remain, which must be set a third time to deposit its impurities, after which it is to be filtered : this filtered liquor contains the phosphoric acid sufficiently pure, to which, heated a little, add purified soda dissolved in warm water until the effervescence ceases. Filter the neutralized liquor, and set it aside to crystallize. The liquor that remains after the crystals are taken out must be farther neutralized by the addition of soda, if necessary, evaporated and set aside to crystallize again ; and this must be repeated as long as any crystals can be obtained.

It is possessed of the same medical qualities as Glauber's and the Rochelle salt, being an excellent purge in the quantity of an ounce or ten drachms.

## ALUMINIS PURIFICATIO.

*Lond.**Purification of Alum.***Take of**

Alum, one pound ;

Chalk, one drachm ;

Distilled water, one pint.

**Boil** them a little, strain, and set the liquor aside to crystallize.

## ALUMEN USTUM.

*Lond. Edinb.**Burnt Alum.***Take of**

Alum, half a pound.

**Burn** it in an earthen vessel until it ceases to bubble.

In this state it is so acrid as to be frequently employed as an escharotic.

*SAL SIVE SACCHARUM LACTIS.*

*Succ.*

Take of milky whey, prepared by rennet, any quantity; let it be boiled over a moderate fire to the consistence of a syrup; then put it in a cold place, that crystals may be formed. Let the fluid which remains be again managed in the same manner, and let the crystals formed be washed with cold water.

This preparation has been greatly celebrated in disorders of the breast, but it is far from answering what has been expected from it.

*SAL ACETOSELLÆ.*

*Succ.*

*Salt of Sorrel.*

Take any quantity of the expressed juice of the leaves of the wood sorrel; let it boil gently, that the feculent matter may be separated; then strain it till it be clear, and after this boil it on a moderate fire to the consistence of a syrup. Put it into long necked glass vessels, and place it in a cold situation that it may crystallize. Let these crystals be dissolved in water, and again formed into purer ones.

The virtues of the essential salts have not been sufficiently determined from experience. Thus much, however, is certain, that they do not, as has been supposed, possess the virtues of the subjects entire, excepting only the acids and sweets.

*SAL ACIDUM BORACIS.*

*Succ.*

*Acid Salt of Borax.*

Take of

Borax, an ounce and a half;

Warm spring water, one pound.

Mix them in a glass vessel, that the borax may be dissolved; then pour into it three drachms of the concentrated vitriolic acid; evaporate the liquor till a pellicle appears upon it; after this let it remain at rest till the crystals be formed. Let them be washed with cold water and kept for use.

This salt has been supposed to be a mild anodyne, to diminish febrile heat, to prevent or remove delirium; and to allay,

at least for some time, spasmodical affections, particularly those which are the attendants of hyponchondriasis and hysteria. It may be given in doses of from two to twenty grains.

SAL AMMONIACUM DEPURATUM.

*Succ.*

Dissolve sal ammoniac in spring water; strain the liquor through paper; evaporate it to dryness in a glass vessel, by means of a moderate fire.

CLASS V. *Earths.*

MAGNESIA ALBA.

*Land.*

*White Magnesia.*

Take of

Vitriolated magnesia,

Kali, each two pounds;

Distilled water, boiling, twenty pints.

Dissolve the vitriolated magnesia and the kali separately in ten pints of water, and filter each through paper; then mix them. Boil the liquor a little while, and strain it while hot through linen, upon which the magnesia will remain; then wash away, by repeated affusions of distilled water, the vitriolated kali.

MAGNESIA ALBA.

*Edin.*

*White Magnesia.*

Take of

Vitriolated magnesia,

Purified lixive, equal weights.

Dissolve them separately in double their quantity of warm water, and let the liquors be strained or otherwise freed from the feces; then mix them, and instantly add eight times their quantity of warm water. Let the liquor boil a little, stirring it very well at the same time; then let it rest till the heat be somewhat diminished; after which strain it through a cloth: the magnesia will remain upon the cloth, and is to be washed with pure water till it be altogether void of saline taste.

A large dose of magnesia, if the stomach contain no acid to dissolve it, neither purges nor produces any sensible effect. A moderate one, if an acid be lodged there, or if acid liquors be taken after it, procures several

stools; whereas the common absorbents, in the same circumstances, instead of loosening, bind the belly.

MAGNESIA USTA.

*Lond.*

*Calined Magnesia.*

Take of

White magnesia, four ounces.

Expose it to a strong heat for two hours; and, when cold, sit it by.

Keep it in a vessel closely stopd.

MAGNESIA USTA.

*Edin.*

*Calined Magnesia*

Let magnesia, put into a crucible, be continued in a red heat for two hours; then put it up in close glass vessels.

The magnesia usta is used for the same general purposes as the magnesia combined with fixed air. In certain affections of the stomach, accompanied with much flatulence, the calcined magnesia is found preferable.

CLASS VI. *Metals.*

HYDRARGYRUS PURIFICATUS.

*Lond.*

*Purified Quicksilver.*

Take of

Quicksilver,

Iron filings, each four pounds.

Rub them together, and distil from an iron vessel.

HYDRARGYRUS ACETATUS.

*Lond. Edin.*

*Acetated Quicksilver.*

Take of

Quicksilver;

Dilute nitrous acid, of each half a pound;

Acetated vegetable alkali, three ounces;

Warm water, two pounds and an half.

Digest the quicksilver with a gentle heat in the dilute nitrous acid for twenty four hours, or till it be dissolved. Pour the nitrated quicksilver, thus prepared, into the solution of the acetated vegetable alkali in the warm water (at about 90 degrees), so that the acetated quicksilver may be formed, which is to be washed with cold water, and afterwards dissolved in a sufficient quantity of warm water. Filter this solution, and set it aside that crystals may be formed.



## HYDRARGYRUS CALCINATUS.

*Lond.**Calined Quicksilver.***Take of**

Purified quicksilver, one pound.

Expose the quicksilver, in a flat-bottomed glass cucurbit, to an heat of about 600 degrees, in a sand-bath, till it becomes a red powder.

It may be advantageously given in conjunction with opiates: a bolus or pill, containing from half a grain to two grains of this calx, and a quarter, half a grain, or more, of opium, with the addition of some warm aromatic ingredient, may be taken every night.

HYDRARGYRUS PRÆCIPITATUS CINEREUS, *vulgo*  
PULVIS MERCURII CINEREUS.*Edinb.*

*Asb-coloured Precipitate of Quicksilver, commonly called Asb-coloured Powder of Mercury.*

**Take of**

Quicksilver,

Dilute nitrous acid, equal weights.

Mix them so as to dissolve the quicksilver: dilute the solution with pure water, and add water of ammonia as much as is sufficient to separate the mercury perfectly from the acid; then wash the powder with pure water, and dry it.

It may be given in a bolus, in the quantity of from one to six or seven grains; the dose being gradually increased according to its effects.

## HYDRARGYRUS CUM CRETA.

*Lond.**Quicksilver and Chalk.***Take of**

Purified quicksilver, three ounces;

Powdered chalk, five ounces.

Rub them together until the globules disappear.

There can be little doubt that the absorbent earth, by destroying acid in the alimentary canal, will diminish the activity of the mercury.

HYDRARGYRUS MURIATUS.

*Lond.*

*Muriated Quicksilver.*

Take of

- Purified quicksilver, two pounds ;
- Vitriolic acid, thirty ounces ;
- Dried sea-salt, four pounds.

Mix the quicksilver with the acid, in a glass vessel, and boil in a sand-heat until the matter be dried. Mix it, when cold, with the sea-salt in a glass vessel ; then sublime in a glass cucurbit, with a heat gradually raised. Lastly, let the sublimed matter be separated from the scorixæ.

HYDRARGYRUS MURIATUS CORROSIVUS, *vulgo* MERCURIUS SUBLIMATUS CORROSIVUS.

*Edin.*

*Muriated Corrosive Quicksilver*, commonly called *Sublimate Corrosive Mercury*.

Take of

- Quicksilver,
- Dilute nitrous acid, of each four ounces ;
- Dry sea-salt,
- Dried vitriolated iron, of each five ounces ;

Dissolve the quicksilver in the nitrous acid, and evaporate the solution to a white and thoroughly dry mass ; then add the sea-salt and vitriolated iron. Having ground and mixed them well together, put the whole into a phial, one half of which they ought to fill ; then sublime in sand, first with a gentle, but afterwards with an increased heat.

Sublimate, dissolved in vinous spirit, has been given internally in larger doses ; from a quarter of a grain to half a grain.

CALOMELAS.

*Lond.*

*Calomel.*

Take of

- Muriated quicksilver, one pound ;
- Purified quicksilver, nine ounces.

Rub them together till the globules disappear, and then sublime the mass. In the same manner repeat the sublimation four times ; afterwards rub the matter into a very fine powder, and wash it by pouring on boiling distilled water.

**HYDRARGYRUS MURIATUS MITIS, *vulgo* CALOMELAS, *sive* MERCURIUS DULCIS.**

*Edin.*

*Mild Muriated Quicksilver, commonly called Calomel, or Sweet Mercury.*

**Take of**

Muriated Corrosive quicksilver, reduced to a powder in a glass mortar, four ounces ;

Pure quicksilver, three ounces and a half.

Mix them well together, by long trituration in a glass or marble mortar, until the quicksilver ceases to appear. Put the powder into an oblong phial, of such a size that only one-third of it may be filled ; and set the glass in sand, that the mass may sublime. After the sublimation break the glass, and the red powder which is found in its bottom, with the whitish one that sticks up at the neck, being thrown away, let the remaining mass be sublimed again three or four times, and reduced to a very fine powder.

*Calomel, or mercurius dulcis, may be considered as one of the most useful of the mercurial preparations, especially in the cases of children.*

**HYDRARGYRUS MURIATUS MITIS.**

*Lon.*

*Mild Muriated Quicksilver.*

**Take of**

Purified quicksilver,

Dilute nitrous acid, of each half a pound.

Mix in a glass vessel, and set it aside until the quicksilver be dissolved. Let them boil, that the salt may be dissolved. Pour out the boiling liquor into a glass vessel, containing a cooling hot solution of four ounces of sea-salt in eight pints of water.

After a white powder has subsided to the bottom of the vessel, let the liquor swimming at the top be poured off, and the remaining powder be washed till it becomes insipid, with frequent affusions of hot water. then dried on blotting paper, with a gentle heat.

**HYDRARGYRUS MURIATUS PRECIPITATUS.**

*Edin.*

*Precipitated Muriated Quicksilver.*

**Take of**

Dilute nitrous acid, eight ounces ;

Quicksilver, eight ounces or a little more.

Pour them into a chemical phial, loosely covered, and let them stand for an hour, avoiding the vapours. Afterwards place the phial in a sand bath for four hours, gradually increasing the heat till the mixture boils for about a quarter of an hour, frequently shaking the vessel occasionally. If the quicksilver be all dissolved, it will be

necessary to add more, that the solution may be a perfectly saturated one. This solution must be poured boiling hot into another vessel, containing a boiling hot solution of four ounces and an half of sea salt in eight pounds of water. The mixture must be performed quickly, and with a brisk agitation of the vessel in which it is made. When the precipitate has subsided, pour off the liquor, and wash the precipitate well by frequent additions of boiling water and subsequent decantations, until no saline taste is perceptible.

HYDRARGYRUS NITRATUS RUBER.

*Lond.*

*Red Nitrated Quicksilver.*

Take of

Purified quicksilver,  
Nitrous acid, of each one pound;  
Muriatic acid, one drachm

Mix in a glass vessel, and dissolve the quicksilver in a sand-bath; then raise the fire until the matter be formed into red crystals.

HYDRARGYRUS NITRATUS RUBER, *vulgo* MERCURIUS PRÆCIPITATUS RUBER.

*Edinb.*

*Red Nitrated Quicksilver, commonly called Red Precipitated Mercury.*

Take of

Quicksilver,  
Diluted nitrous acid, of each one pound.

Let the quicksilver be dissolved in the acid, and then let the solution be evaporated to a white dry mass. This being beat into a powder, must be put into a glass cucurbit, and subjected to a fire gradually increased, constantly stirring the mass with a glass rod, that it may be equally heated, till a small quantity of it taken out in a glass spoon and allowed to cool, assumes the form of shining red squame; when the vessel is to be removed from the fire.

Some have ventured to give this medicine internally, in venereal, scrophulous, and other obstinate chronic disorders, in doses of two or three grains, or more.

CALX HYDRARGYRI ALBA.

*Lond.*

*White Calx of Quicksilver.*

Take of

Muriated quicksilver,  
Sal ammoniac,  
Water of kali, each half a pound.

Dissolve first the sal ammoniac, afterwards the muriated quicksilver, in distilled water, and add the water of kali. Wash the precipitated powder until it becomes insipid.

This preparation is used chiefly in ointments.

#### HYDRARGYRUS CUM SULPHURE.

*Land.*

*Quicksilver with Sulphur.*

Take of

Purified quicksilver,

Flowers of sulphur, each one pound.

Rub them together until the globules disappear.

#### HYDRARGYRUS SULPHURATUS NIGER, *vulgo* ÆTHIOPS MINERALIS.

*Edinb.*

*Black Sulphurated Quicksilver, commonly called Ethiop's Mineral.*

Take of

Quicksilver,

Flowers of sulphur, each equal weights.

Grind them together in a glass or stone mortar, with a glass pebble, till the mercurial globules totally disappear.

An Ethiops is made also with a double quantity of mercury.

#### HYDRARGYRUS SULPHURATUS RUBER.

*Land.*

*Red Sulphurated Quicksilver.*

Take of

Quicksilver purified, forty ounces;

Sulphur, eight ounces.

Mix the quicksilver with the melted sulphur; and if the mixture takes fire, extinguish it by covering the vessel; afterwards reduce the mass to powder, and sublime it.

Cinnabar is sometimes used in fumigations against venereal ulcers in the nose, mouth, and throat. Half a drachm of it burnt, and the fume taken in with the breath, has occasioned a violent salivation.

#### HYDRARGYRUS VITRIOLATUS.

*Land.*

*Vitriolated Quicksilver.*

Take of

Purified quicksilver, one pound;

Vitriolic acid, fifteen ounces.

Mix in a glass vessel, and heat them by degrees, until they unite into a white mass, which is to be perfectly dried with a strong fire. This matter, on the affusion of a large quantity of hot distilled water, immediately becomes yellow, and falls to powder. Rub the powder carefully with this water in a glass mortar. After the powder has subsided, pour off the water; and adding more distilled water several times, wash the matter till it becomes insipid.

**HYDRARGYRUS VITRIOLATUS FLAVUS, vulgo TUR-  
PETHUM MINERALE.**

*Edinb.*

*Yellow Vitriolated Quicksilver, commonly called Turbith Mineral.*

Take of

Quicksilver, four ounces;

Vitriolic acid, eight ounces.

Cautiously mix them together, and distil in a retort, placed in a sand-furnace, to dryness; the white calx, which is left at the bottom, being ground to powder, must be thrown into warm water. It immediately assumes a yellow colour, but must afterwards be purified by repeated ablutions.

This medicine was lately recommended as the most effectual preservative against the hydrophobia. The washings of turbith mineral are used by some, externally, for the cure of the itch and other cutaneous foulnesses.

**SOLUTIO MERCURIALIS SIMPLEX.**

*Jo. Jac. Plenck.*

*Simple Mercurial Solution.*

Take of

Purest quicksilver, one drachm;

Gum arabic, two drachms.

Rub them in a stone mortar, adding by little and little distilled water of fumitory, till the mercury thoroughly disappear in the mucilage.

Having beat and mixed them thoroughly, add by degrees, and at the same time rubbing the whole together,

Syrup of kermes, half an ounce;

Distilled water of fumitory, eight ounces.

**GENERAL TABLE OF MERCURY.**

Mercury, purified by distillation, is always employed in medicine in a state of oxydation, and this is either effected by

1. Triture, as in the

1. Pil. Hydrargyri. L. et E.

Hydragyrus cum creta. L.

Emplast. hydrargyr. five cæul. E.  
 ——— Lichargyr. cum hydrargyr. L.  
 ——— Ammoniaci cum hydrargyr. L.  
 Ungt. hydrargyr. five cæul. E.  
 ——— fort. et mitius. L.

2. Calcination, (the action of heat and air,) as in the  
 Hydrargyrus calcinatus. L.

### 3. Acids, as by the

1. SULPHURIC ACID, in the  
 Hydrargyr. vitriolat. flavus, or turpeth mineral. E.  
 ——— vitriolatus. L.

2. NITRIC ACID, in the  
 Ungt. hydrargyr. nitrat. L. et E.  
 ——— nitrat. ruber. L. et E.

3. MURIATIC ACID, in the  
 Hydrargyrus muriatus corrosivus. E.  
 Hydrargyrus muriatus. L.  
 Hydrargyrus muriatus mitis. E.  
 Calomelas. L.  
 Hydrargyrus muriatus precipitat. E.  
 Hydrargyrus muriatus mitis. L.

4. ACETOUS ACID, in the  
 Hydrargyrus acetatus. L. et E.  
 Pilulæ Keyseri.

5. PHOSPHORIC ACID, in the  
 Hydrargyrus phosphoratus.

### 3. Mercury is deoxygenated in part,

1. In the Calcined State by its Union with SULPHUR, as in the  
 Hydrargyrus sulphuratus niger. E.  
 ——— cum sulphure. L.  
 Hydrargyrus sulphuratus ruber. L.  
 Pilulæ hydrargyri muriat mitis, five calomelanos compositz. E.

2. In the Saline State, by its Precipitation by ALKALIES, as  
 in the  
 Hydrargyr. precipit. cinereus. E.  
 Calx hydrargyr. alba. L.  
 Ungt. calcis hydrargyr. albæ. L.

*Preparations of Antimony.*

ANTIMONIUM CALCINATUM.

*Lond.*

*Calined Antimony.*

**Take of**

Antimony, powdered, eight ounces;

Nitre, powdered, two pounds.

Mix them, and cast the mixture by degrees into a red hot crucible.

Burn the white matter about half an hour; and, when cold, powder it; after which wash it with distilled water.

ANTIMONIUM USTUM CUM NITRO, *vulgo* CALX  
ANTIMONII NITRATA.

*Edmb.*

*Nitrated Calx of Antimony.*

**Take of**

Antimony, calcined for making the glass of antimony,

Nitre, equal weights.

Having mixed, and put them into a crucible, let them be heated, so that the matter shall be of a red colour for an hour; then let it be taken out of the crucible, and, after powdering it, let it be repeatedly washed with warm water till it becomes insipid.

It is in all cases uncertain in operation: sometimes proving perfectly inert, and at other times very violent in its effects.

CROCUS ANTIMONII. *l*

*Lond.*

*Crocus of Antimony.*

**Take of**

Antimony, powdered;

Nitre, powdered, of each one pound;

Sea-salt, one ounce.

Mix, and put them by degrees into a red hot crucible, and melt them with an augmented heat. Pour out the melted matter; and, when cold, separate it from the scoriae.

CROCUS ANTIMONII, *vulgo* CROCUS METALLORUM.

*Edmb.*

*Crocus of Antimony, commonly called Crocus of Metals.*

**Take of**

Antimony,

Nitre, equal weights.



After they are separately powdered and well mixed, let them be injected by degrees into a red-hot crucible; when the detonation is over, separate the reddish metallic matter from the whitish crust; powder it and edulcorate it by repeated washings with hot water, till the water come off insipid.

Their principal use is in maniacal cases, or as the basis of some other preparations.

#### ANTIMONIUM MURIATUM.

*Lond.*

*Muriated Antimony.*

#### ANTIMONIUM MURIATUM, *vulgo* BUTYRUM ANTIMONII.

*Edinb.*

*Muriated Antimony, commonly called Butter of Antimony.*

Take of

Crocus of antimony, powdered,

Vitriolic acid, each one pound;

Dry sea-salt, two pounds.

Pour the vitriolic acid into a retort, adding by degrees the sea-salt and crocus of antimony, previously mixed; then distil in a sand-bath. Let the distilled matter be exposed to the air several days, and then let the fluid part be poured off from the dregs.

It is sufficiently strong for the purposes of consuming fungous flesh and the callous lips of ulcers.

#### PULVIS ANTIMONIALIS.

*Lond.*

*Antimonial Powder.*

Take of

Antimony, coarsely powdered,

Hartshorn shavings, each two pounds.

#### ANTIMONIUM CALCAREO PHOSPHORATUM, *five* PULVIS ANTIMONIALIS.

*Edinb.*

*Calcareo-Phosphorated Antimony, or Antimonial Powder.*

Take of

Antimony, in coarse powder, two pounds;

Saw-dust of bones, ivory, or hartshorn, two pounds.

Mix, and put them into a wide red-hot iron pot, stirring constantly till the mass acquires a grey colour. Powder the matter when cold,

and put it into a coated crucible. Lute to it another crucible inverted, which has a small hole in its bottom; augment the fire by degrees to a red heat, and keep it so for two hours. Lastly, reduce the matter, when cold, to a very fine powder.

This powder is given as an alterative and sudorific in doses of about five, six, or seven grains; in which quantity it frequently produces nausea, and sometimes vomiting and purging. Its principal use is in removing obstructions or suppressions of the insensible perspiration which so often produce fevers.

SULPHUR ANTIMONII PRÆCIPITATUM.

*Lond.*

*Precipitated Sulphur of Antimony.*

Take of

Antimony, powdered, two pounds;

Water of pure kali, four pints;

Distilled water, three pints.

Mix, and boil them with a slow fire for three hours, constantly stirring, and adding distilled water as it shall be wanted; strain the hot ley through a double linen cloth, and into the liquor, while yet hot, drop by degrees as much diluted vitriolic acid as is sufficient to precipitate the sulphur. Wash off the vitriolated kali with warm water.

SULPHUR ANTIMONII PRÆCIPITATUM, *vulgo* SULPHUR AURATUM ANTIMONII.

*Ed. nb.*

*Precipitated Sulphur of Antimony, commonly called Golden Sulphur of Antimony.*

Take of

Caustic ley, four pounds;

Water, three pounds;

Antimony powdered two pounds.

Boil them in a covered iron pot for three hours, adding more water if necessary, frequently stirring the mixture with an iron spatula; strain the liquor while warm through a double cloth, and add as much diluted vitriolic acid as is necessary to precipitate the sulphur, which must be well washed with plenty of water.

They prove emetic when taken on an empty stomach, in a dose of four, five, or six grains; but at present they are scarcely prescribed with this intention; being chiefly used as alterative deobstruents, particularly in cutaneous disorders.

## ANTIMONIUM TARTARISATUM.

Lond.

*Tartarified Antimony.*

Take of

Crocus of antimony, powdered, one pound and an half;

Crystals of tartar, two pounds;

Distilled water, two gallons.

Boil in a glass vessel about a quarter of an hour; filter through paper, and let aside the strained liquor to crystallize.

ANTIMONIUM TARTARISATUM. *vulgo* TARTARUS EMPTICUS.

Edinb.

*Tartarified Antimony, commonly called Emetic Tartar.*

Take of

Muriated antimony what quantity you please; pour it into warm water, in which a proper quantity of persulf live has been previously dissolved, that the antimonial powder may be precipitated, which after being well washed is to be dried.

Then to five pounds of water add of this powder nine drachms, and of crystals of tartar, in very fine powder, two ounces and a half; boil for a little till the powders be dissolved.

Let the strained solution be slowly evaporated in a glass vessel to a pellicle, so that crystals may be formed.

The dose of emetic tartar, when designed to produce the full effect of an emetic, is from two to four grains. It may likewise be advantageously given in much smaller doses, as a nauseating and sudorific medicine.

## ANTIMONIUM VITRIFICATUM.

Lond.

*Vitrified Antimony.*

Take of

Powdered antimony, four ounces

Calcine in a broad earthen vessel with a fire gradually raised, stirring it with an iron rod until it no longer emits smoke. Put this powder into a crucible, so as to fill two thirds of it. A cover being fitted on, make a fire under it, at first moderate, afterwards stronger, until the matter be melted. Pour out the melted glass.

## VITRUM ANTIMONII.

Edinb.

*Glass of Antimony.*

Sieve antimony, beat into a coarse powder like sand, upon a shallow ungazed earthen vessel, and apply a gentle heat underneath, that

the antimony may be heated slowly ; keeping it at the same time constantly stirring to prevent it from running into lumps. White vapours of a sulphureous smell will arise from it. If they cease to exhale with the degree of heat first applied, increase the fire a little, so that vapours may again arise: go on in this manner, till the powder, when brought to a red heat, exhales no more vapours. Melt this powder in a crucible with an intense heat, till it assumes the appearance of melted glass; then pour it out on a heated brass plate or dish.

It is frequently employed in the formation of emetic tartar.

VITRUM ANTIMONII CERATUM.

*Edinb.*

*Cerated Glass of Antimony.*

Take of

Yellow wax, a drachm ;

Glass of antimony, reduced into powder, an ounce.

Melt the wax in an iron vessel, and throw into it the powdered glass ; keep the mixture over a gentle fire for half an hour, continually stirring it ; then pour it out on paper, and when cold, grind it into powder.

The dose of this medicine is from ten grains to twenty or thirty : it is said to operate mildly both upwards and downwards, and sometimes to prove sudorific.

CERUSSA ANTIMONII.

*Brun.*

*Cerussa of Antimony.*

Take of

Regulus of antimony, one part ;

Nitre, three parts

Deflagrate them together in the manner directed for the antimonium calcinatum.

KERMES MINERALE.

*Succ.*

*Kermes Mineral.*

Take of

Cru'le antimony, powdered, half a pound ;

Fixed vegetable alkali, two pounds ;

Boiling water, eight pounds

Roil them together in an iron pot for a quarter of an hour, continually stirring the mixture with an iron spatula, and filter as speedily as

possible while it is hot. The filtered liquor, set in a cool place, will soon deposit a powder, which must be repeatedly washed, first with cold, and afterwards with warm, water until it be perfectly insipid.

This medicine has been long greatly esteemed, especially in France.

#### PANACEA ANTIMONII.

*Panacea of Antimony.*

##### Take of

Antimony, six ounces ;  
Nitre, two ounces ;  
Common salt, an ounce and a half ;  
Charcoal, an ounce .

Reduce them into a fine powder, and put the mixture into a red hot crucible, by half a spoonful at a time, continuing the fire a quarter of an hour after the last injection ; then either pour the matter into a cone, or let it cool in the crucible ; which when cold must be broken to get it out. In the bottom will be found a quantity of regulus ; above this a compact liver-coloured substance ; and on the top a more spongy mass ; this last is to be reduced into powder, edulcorated with water, and dried, when it appears of a fine golden colour.

Ten grains of the powder, mixed with an ounce of white sugar candy, and made into a mass with mucilage of gum tragacanth, may be divided into an hundred small pills ; of which one, two, or three, taken at a time, are said to work gently by stool and vomit.

#### TABLE OF ANTIMONY.

Antimony is chiefly employed in medicine in the state of oxydation, and this oxyd is procured either from its sulphuret or its pure state.

##### I. Antimony in the form of the triturated sulphuret.

*Antimonium preparatum* (L. et E.) is oxydated by

##### i. Calcination, (or the action of heat and air,) as in the

*Flores antimonii sine addito.*

*Vitrum antimonii.* E.

*Antimonium vitrificatum.* L.

*Vitrum antimonii ceratum.* E.

##### 2. Acids, as in the

*Antimonium vitriolatum.* Klappig.

*Antimonium catharticum.* Wilson.

Antimonium muriatum, vulgo Butyr. Antim. E.

Antimonium muriatum. L.

Pulvis algarothi, vulgo mercurius vitæ.

Bezoardicum minerale.

Antim. tartarifat. vulgo tartar emetic. E.

Antim. tartarifat. E. et L.

Vinum antim tartarifat. E. et L.

Vinum antimonii. L.

### 3. Nitre.

Crocus antimonii mitissimus,

Vulgo regulus antimonii medicinalis.

Crocus antimonii. E. et L.

Antimonii emeticum mitius. Boerh.

Antimonium ustum cum nitro, vulgo calx antimonii nitrata. E.

Antimonium calcinatum, vulgo diaphoret. L.

Antimonium calcareo-phosphoratum, sive pulvis antimonialis. E.

Pulvis antimonialis. L.

### 4. Alkalies.

Hepar antimonii mitissimus

Regulus antimonii medicinalis.

Hepar ad Kermes minerale. Geoffroi.

Hepar ad tincturam antimonii.

Kermes mineralis.

Sulphur antimonii præcipitatum. E. et L.

II. Antimony, in its pure state, under the forms of

Regulus antimonii simplex,

Regulus antimonii martialis,

Regulus Jovialis, are oxydized by

1. Calcination, (or the action of heat and air,) as in the  
Flores argenti, vulgo nix antimonii.

2. Nitre, as in the

Cerussa antimonii.

Stomaichicum poterii.

Antihæsticum poterii.

Cardiacum poterii.

### *Preparations of Silver.*

ARGENTUM NITRATUM.

*Lond.*

*Nitrated Silver.*

Take of

Silver, one ounce;

Dilute nitrous acid, four ounces.

Dissolve the silver in the nitrous acid, in a glass vessel with a sand-heat; then evaporate with an heat gently raised; afterwards melt the residuum in a crucible, carefully avoiding too a great a heat, and pour it into proper moulds.

**ARGENTUM NITRATUM, vulgo CAUSTICUM LUNARE.**

*Edinb.*

*Nitrated Silver, commonly called Lunar Caustic.*

**Take of**

Purest silver, beat thin and cut in pieces, four ounces;

Dilute nitrous acid, eight ounces;

Distilled water, four ounces.

Dissolve the silver in a phial with a gentle heat, and evaporate the solution to dryness; then put the mass into a large crucible, and apply the heat, at first gently, but augment it by degrees till the mass flows like oil; then pour it into iron moulds, previously heated, and greased with tallow. The lunar caustic must be kept in well stopp'd phials.

This preparation is a strong caustic; and is frequently employed as such, for consuming warts and other fleshy excrescences, keeping down fungous flesh in wounds or ulcers, and other similar uses.

**PILULÆ LUNARES.**

*The Lunar Pills.*

Dissolve pure silver in aqua fortis, as in the foregoing process; and after due evaporation, set the liquor to crystallize. Let the crystals be again dissolved in common water, and mixed with a solution of equal their weight of nitre. Evaporate this mixture to dryness, and continue the exsiccation with a gentle heat, keeping the matter constantly stirring till no more fumes arise.

Boerhaave, Boyle, and others, commend it highly in hydropic cases. It is used also in nervous affections.

*Preparations of Iron.*

**FERRI LIMATURA PURIFICATA.**

*Edinb.*

*Purified Iron Filings.*

Cover the filings with a piece of gauze, or with the bottom of a fine sieve, and through this draw the iron filings with a magnet.

FERRI SQUAMÆ PURIFICATÆ.

*Edinb.*

*Purified Iron Scales.*

Let iron scales (collected at the foot of a blacksmith's anvil) be purified by means of a magnet. The magnet will attract only the smaller and more pure scales, leaving the larger and more impure behind.

FERRUM AMMONIACALE.

*Lond.*

*Ammoniacal Iron.*

Take of

Iron filings, one pound;

Sal ammoniac, two pounds.

Mix, and sublime. What remains at the bottom of the vessel mix by rubbing together with the sublimed matter, and again sublime.

FERRUM AMMONIACUM, *vulgo* FLORES MARTIALES.

*Edinb.*

*Ammoniated Iron, commonly called Martial Flowers.*

Take of

Burnt vitriolated iron, washed and well dried,

Sal ammoniac, equal weights.

Having mixed them well, sublime.

It has been found of service in hysterical and hypochondriacal cases, and in distempers proceeding from a laxity and weakness of the solids, as the rickets.

FERRI RUBIGO.

*Lond. \**

*Rust of Iron.*

Take of

Iron filings, one pound.

Expose them to the air, often moistening them with water, until they be corroded into rust; then powder them in an iron mortar, and wash off with distilled water the very fine powder.

But the remainder, which cannot by moderate rubbing be reduced into a powder, capable of being easily washed off, must be moistened, exposed to the air for a longer time, and again powdered and washed as before. Let the washed powder be dried.

FERRI RUBIGO, *vulgo* FERRI LIMATURA PREPARATA.

*Edinb.*

*Rust of Iron, commonly called Prepared Iron Filings.*

Set purified iron filings in a moist place, that they may turn to rust, which is to be ground into an impalpable powder.



The rust of iron is preferable, as a medicine, to the calces, or croci, made by a strong fire. The dose is from four or five grains to twenty or thirty.

**FERRUM TARTARISATUM.**

*Lond.*

*Tartarised Iron.*

Take of

Iron filings one pound;

Powdered crystals of tartar, two pounds.

Mix them with distilled water into a thick paste. Expose it to the air in an open earthen vessel for eight days; then dry the matter in a sand-bath, and reduce it to a very fine powder.

It may be given in a liquid form, or in a bolus, in doses of from five grains to a scruple, twice or thrice a day.

**FERRUM VITRIOLATUM.**

*Lond.*

*Vitriolated Iron.*

Take of

Iron filings,

Vitriolic acid, each eight ounces;

Distilled water, three pints.

Mix them in a glass vessel; and, when the effervescence has ceased, place the mixture for some upon hot sand; then pour off the liquor, straining it through paper; and, after due exhalation, set it aside to crystallize.

**FERRUM VITRIOLATUM, vulgo SAL CHALYBIS.**

*Edinb.*

*Vitriolated Iron, commonly called Salt of Steel.*

Take of

Purified iron filings, six ounces;

Vitriolic acid, eight ounces;

Water, two pounds and a half.

Mix them, and when the effervescence ceases, let the mixture stand for some time upon warm sand; then strain the liquor through paper, and after due evaporation set it aside to crystallize.

The vitriolated iron is one of the most efficacious preparations of this metal; and frequently used in cachectic and chlorotic cases, for exciting the uterine purgations, strengthening the tone of the viscera, and destroying worms. Four or five grains, and in many cases half a

grain, are sufficient for the intention in which chalybeate medicines are given.

FERRUM VITRIOLATUM EXSICCATUM, *vulgo* VITRIOLATUM CALCINATUM.

*Edinb.*

*Dried Vitriolated Iron, commonly called Calcined Vitriol.*

Take of

Vitriolated iron, as much as you please.

Let it be calcined in an unglazed earthen vessel, with a moderate heat, till it becomes white and perfectly dry.

FERRUM VITRIOLATUM USTUM, *vulgo* COLCOTHAR VITRIOLI.

*Edinb.*

*Burnt Vitriolated Iron, commonly called Colcothar of Vitriol.*

Let dried vitriolated iron be urged with a violent fire till it becomes of a very red colour.

The colcothar is very rarely employed.

ÆTHIOPS MARTIALIS.

*Gen.*

*Martial Ethiops.*

Take of

Rust of iron, as much as you please;

Olive oil, a sufficient quantity to make it into a paste.

Let this be distilled in a retort by a strong fire to dryness. Keep the residuum reduced to a fine powder in a close vessel.

It is not in general supposed to have any advantage over the other more common chalybeates.

*Preparations of Lead.*

MINIUM.

*Red Lead.*

Let any quantity of lead be melted in an unglazed earthen vessel, and kept stirring with an iron spatula till it falls into a powder, at first blackish, afterwards yellow, and at length of a deep red colour, in which last state it is called *minium*; taking care not to raise the fire so high as to run the calx into a vitreous mass.

These calces are employed in external applications for abating inflammations, cleansing and healing ulcers, and the like.

## CERUSSA.

*Cerusse, or White Lead.*

Put some vinegar into the bottom of an earthen vessel, and suspend over the vinegar very thin plates of lead, in such a manner that the vapour which arises from the acid may circulate about the plates. Set the containing vessel in the heat of horse dung for three weeks; if at the end of this time the plates be not properly calcined, scrape off the white powder, and expose them again to the steam of vinegar, till all the lead be thus corroded into powder.

It proves externally, when sprinkled on running sores, or ulcers, moderately cooling, drying, and astringent.

## CERUSSA ACETATA.

*Lond.**Acetated Cerusse.*

Take of

Cerusse, one pound;

Distilled vinegar, one gallon.

Boil the cerusse with the vinegar until the vinegar is saturated; then filter through paper; and, after proper evaporation, set it aside to crystallize.

CERUSSA ACETATA, *vulgo* SACCHARUM SATURNI.*Edinb.**Acetated Cerusse, commonly called Sugar of Lead.*

Put any quantity of cerusse into a cucurbit, and pour upon it ten times its quantity of distilled vinegar. Let the mixture stand upon warm sand till the vinegar becomes sweet; when it is to be poured off, and fresh vinegar added as often as it comes off sweet. Then let all the vinegar be evaporated in a glass vessel to the consistence of pretty thin honey, and set it aside in a cold place, that crystals may be formed, which are to be afterwards dried in the shade. The remaining liquor is again to be evaporated that new crystals may be formed; the evaporation of the residuous liquor is to be repeated till no more crystals concrete.

The sugar of lead is much more efficacious than the foregoing preparations, in answering the several intentions to which they are applied. Some have ventured upon it internally, in doses of a few grains, as a styptic, in hæmorrhages, profuse colliquative sweats, seminal fluxes, the fluor albus, &c. nor has it failed their expectations. It very powerfully restrains the discharge; but almost as certainly as it does this, it occasions symptoms of another

kind, often more dangerous than those removed by it, and sometimes fatal.

AQUA LITHARGYRI ACETATI.

*Lond.*

*Water of Acetated Litharge.*

Take of

Litharge, two pounds and four ounces ;

Distilled vinegar, one gallon.

Mix, and boil to six pints, constantly stirring ; then set it aside.

After the fæces have subsided, strain.

This preparation may be considered as nearly the same with the extract and vegeto-mineral water of Mr. Goulard.

*Preparations of Tin.*

PULVIS STANNI.

*Lond.*

*Tin Powder.*

Take of

Tin, four ounces.

Melt it, and take off the film formed on its surface ; then pour it into a clear iron vessel, and either by agitation or rubbing reduce it to a powdery state ; pass the finer parts through a hair sieve.

It is often employed as a remedy against worms, particularly the flat kinds, which too often elude the force of other medicines. The general dose is from a scruple to a drachm.

STANNI AMALGAMA.

*Dan.*

*Amalgama of Tin.*

Take of

Shavings of pure tin, two ounces ;

Pure quicksilver, three drachms.

Let them be rubbed to a powder in a stone mortar.

Some have imagined that tin thus acted on by mercury, is in a more active condition than when exhibited in the state of powder, and accordingly it has been given in worm cases.

*Preparations of Zinc.*

## ZINCUM CALCINATUM.

*Lond.**Calined Zinc.*

Take of

Zinc, broken into small pieces, eight ounces.

Cast the pieces of zinc, at several times, into an ignited large and deep crucible, placed leaning, or half-upright, putting on it another crucible in such a manner that the air may have free access to the burning zinc.

Take out the calx as soon as it appears, and separate its white and lighter part by a fine sieve.

ZINCUM USTUM, *vulgo* FLORES ZINCI.*Edinb.**Burnt Zinc, commonly called Flowers of Zinc.*

Let a large crucible be placed in a furnace, in an inclined situation, only half upright; when the bottom of the vessel is moderately red, put a small piece of zinc, about the weight of a drachm, into it: the zinc soon flames, and is at the same time converted into a spongy calx, which is to be raked from the surface of the metal with an iron spatula, that the combustion may proceed the more speedily: when the zinc ceases to flame, take the calx out of the crucible. Having put in another piece of zinc, the operation may be repeated as often as you please. Lastly, the calx is to be prepared like antimony.

The flowers of zinc have been much celebrated of late years in the cure of epilepsy, and several spasmodic affections. They ought to be given at first in very small doses, as a grain or two twice a day: and the dose gradually increased to seven or eight grains.

ZINCUM VITRIOLATUM, *vulgo* VITRIOLUM ALBUM.*Edinb.**Vitriolated Zinc, commonly called White Vitriol.*

Take of

Zinc, cut into small pieces, three ounces;

Vitriolic acid, five ounces;

Water, twenty ounces.

Having mixed the acid and water, add the zinc, and when the ebullition is finished strain the liquor; then after proper evaporation set it apart in a cold place, that it may shoot into crystals.

This salt is an elegant white vitriol.

ZINCUM VITRIOLATUM.

*Lond.*

*Vitriolated Zinc.*

Take of

White vitriol, one pound;

Vitriolic acid, one drachm;

Boiling distilled water, three pints.

Mix, and filter through paper. After a proper evaporation, set it aside in a cold place to crystallize.

*Preparations of Copper.*

CUPRUM AMMONIACUM.

*Edinb.*

*Ammoniacal Copper.*

Take of

Vitriolated copper, two parts;

Prepared ammonia, three parts.

Rub them together in a glass mortar, until they unite, after the effervescence ceases, into a uniform violet-coloured mass, which must be first dried on blotting paper, and afterwards by a gentle heat. The product must be kept in a glass phial well closed with a glass stopper.

This preparation has been thought serviceable in epilepsies. It is employed by beginning with doses of half a grain, twice a day; and increasing them gradually to as much as the stomach will bear.

AQUA ÆRUGINIS AMMONIATÆ, *vulgo* AQUA SAPHARINA.

*Edinb.*

*Water of Ammoniated Verdigris, commonly called Sapphire Water.*

Take of

Lime water, fresh made, eight ounces;

Sal ammoniac, two scruples;

Verdigris powdered, four grains.

Mix them, and after twenty-four hours filter the liquor.

This water is used externally for cleaning foul ulcers, and disposing them to heal.

AQUA CUPRI VITRIOLATA COMPOSITA, *vulgo* AQUA STYPTICA.

*Edinb.*

*Compound Water of Vitriolated Copper, commonly called Styptic Water.*

Take of

Vitriolated copper,

Alum, of each three ounces ;  
 Water, two pounds ;  
 Vitriolic acid, one ounce and an half.

Boil the salts in the water that they may be dissolved, and to the filtered liquor add the vitriolic acid.

This styptic water is somewhat similar to the old *aqua aluminosa Batiana* of the former pharmacopœias.

### *Decoctions and Infusions.*

After the several classes of medical substances described, we come next to vegetables, the forms of which, or at least the forms in which the vegetable substance predominates, are more varied than what we have hitherto considered.

Most vegetable substances impart their virtues to water, and this they do more readily in a dried than in a fresh state, which is assisted sometimes by the application of heat; too much heat, however, is improper in the more aromatic vegetables, as their volatile parts are dissipated by it, but it may be applied to those of a more fixed nature, and is sometimes necessary to extract all the virtues of particular substances; yet this circumstance is by no means so general, and cold infusions are found for the most part more fully impregnated with the medicinal qualities than the hot ones.

### DECOCTUM ALTHÆÆ.

*Edinb.*

*Decoction of Marshmallows.*

Take of

Dried marshmallow roots, four ounces ;  
 Radins of the sun, stoned, two ounces ;  
 Water, seven pounds.

Boil to five pounds; place apart the strained liquor till the feces have subsided, then pour out the clear liquor.

This forms a useful demulcent in nephritic cases, and wherever acrimony takes place in the discharge by the kidneys.

### DECOCTUM CORNU CERVI.

*Lond.*

*Decoction of Hartshorn.*

Take of

Burnt and prepared hartshorn, two ounces ;

Gum arabic, six drams;

Distilled water, three pints.

oil, constantly stirring, to two pints, and strain.

This forms the drink in acute diseases attended with iarrhæa, and where much acrimony prevails in the primæ viæ.

POTIO CRETACEA.

*Lond.*

*Chalk Juice.*

Take of

Prepared chalk, one ounce;

Purest refined sugar, half an ounce;

Mucilage of gum arabic, two ounces;

tub them together; and add by degrees;

Water, two pounds, and a half;

Spirituos cinnamon water, two ounces.

Mix them.

This is the best form of exhibiting chalk; it is useful wherever an acrimony prevails in the primæ viæ, connected with an acid cause.

DECOCTUM CORTICIS PERUVIANI.

*Lond.*

*Decoction of Peruvian Bark.*

Take of

Peruvian bark, powdered, one ounce;

Distilled water, one pint and three ounces.

Boil, for ten minutes, in a covered vessel, and strain the liquor whilst hot.

In this form all the strengthening virtues of the bark are contained, and it may be given in doses of two or three ounces.

DECOCTUM PRO ENEMATE.

*Lond.*

*Decoction for a Clyster.*

Take of

The dried leaves of mallow, one ounce;

Dried chamomile-flowers, half an ounce;

Water, one pint.

Boil, and strain.

The virtues of this form chiefly depend on the quantity of the fluid introduced more than any thing in the composition.



## DECOCTUM PRO FOMENTO.

*Lond.**Decoction for Fomentation.***Take of**

The dried leaves of southern-wood,  
 The dried tops of sea-wormwood,  
 Dried chamomile-flowers, each one ounce;  
 Dried bay-leaves, half an ounce;  
 Distilled water, six pints.

**Boil them a little, and strain.****This form depends much for its virtues on the warm fluid**

## DECOCTUM COMMUNE.

*Edinb.**Common Decoction.***Take of**

Camomile-flowers, one ounce;  
 Carvy-seeds, half an ounce;  
 Water, five pounds.

**Boil a quarter of an hour, and strain.**

## DECOCTUM HELEBORI.

*Lond.**Decoction of Hellebore.***Take of**

The root of white hellebore, powdered, one ounce;  
 Distilled water, two pints;  
 Rectified spirit of wine, two ounces.

**Boil the water with the root to one pint; and, the liquor being cold and strained, add to it the spirit.****This is sometimes used in cutaneous diseases, particularly the tinea.**

## DECOCTUM HORDEI.

*Lond.**Decoction of Barley.***Take of**

Pearl-barley, two ounces;  
 Distilled water, four pints.

**The barley being first washed with cold water from the adhering impurities, pour upon it about half a pint of water, and boil the barley a little time. This water being thrown away, add the distilled water, boiling, to the barley; boil it to two pints, and strain.****This is a useful form for the purposes of dilution in acute diseases.**

DECOCTUM HORDEI COMPOSITUM.

*Lond.*

*Compound Decoction of Barley.*

Take of

The decoction of barley, two pints;

Raisins, stoned,

Figs, sliced, each two ounces;

Liquorice-root, sliced and bruised, half an ounce;

Distilled water, one pint.

Boil to two pints, and strain.

DECOCTUM HORDEI.

*Edinb.*

*Barley Water.*

Take of

Pearl-barley, two ounces;

Water, five pints.

First wash the barley from the mealy matter that adheres to it with some cold water; then boil it a little with about half a pint of fresh water, which will acquire a considerable tinge from it. Throw away this tinged water; put the barley into the water prescribed, made first to boil; and continue the boiling till half the water be wasted.

DECOCTUM LIGNORUM.

*Edinb.*

*Decoction of the Woods.*

Take of

Guaiacum saw-dust, three ounces;

Raisins of the sun, stoned, two ounces;

Sassafras wood, shaved,

Liquorice, sliced, each one ounce,

Water, ten pounds.

Boil the guaiacum and raisins with the water, over a gentle fire, to the consumption of one half; adding, towards the end, the sassafras and liquorice. Strain out the liquor; and having suffered it to rest for some time, pour off the clear from the feces without expression.

This has been long celebrated in cutaneous diseases, when taken daily in the quantity of a pint joined with a mercurial or antimonial alterative.

DECOCTUM SARSAPARILLÆ.

*Lond.*

*Decoction of Sarsaparilla.*

Take of

The root of sarsaparilla, sliced, six ounces;

Distilled water, eight pints.

Macerate for two hours, with an heat of about 195°; then take out the root, and bruise it; return the bruised root to the liquor, and again

macerate it for two hours. Then, the liquor being boiled to the measure of four pints, press it out, and strain.

This is a mild alterative, possessing the qualities of a mild mucilaginous substance with much dilution: a pint or more should be used daily.

#### DECOCTUM SARSAPARILLÆ COMPOSITUM.

*Lond.*

*Compound Decoction of Sarsaparilla.*

Take of

The root of sarsaparilla, sliced and bruised, six ounces;  
Bark of the root of sassafras,  
Shavings of guaiacum-wood,  
Liquorice-root, bruised, of each one ounce;  
Bark of the root of mezereon, three drams;  
Distilled water, ten pints.

Macerate, with a gentle heat, for six hours; then boil it down to five pints, adding towards the end of the boiling the bark of the root of mezereon, and strain the liquor.

This is more active as an alterative than the former, and has been much celebrated as the Lisbon drink.

#### DECOCTUM SENEKÆ.

*Edinb.*

*Decoction of Seneka.*

Take of

Seneka, or rattlesnake-root, one ounce;  
Water, two pounds.

Boil to sixteen ounces, and strain.

This decoction has been much used in chronic rheumatism, in gout, and dropsy, without obstruction, in the quantity of two ounces four times a day.

#### DECOCTUM ULMI.

*Lond.*

*Decoction of Elm.*

Take of

The fresh inner-bark of elm, bruised, four ounces;  
Distilled water, four pints.

Boil to two pints, and strain.

The beech decoction has been much celebrated in cutaneous diseases, but it is used with doubtful success.

#### MUCILAGO AMYLI.

*Lond.*

*Mucilage of Starch.*

Take of

Starch, three drams;

Distilled water, one pint.  
Rub the starch, by degrees adding the distilled water; then boil it a little time.

MUCILAGO ARABICI GUMMI.

*Lond.*

*Mucilage of Gum Arabic.*

Take of

Gum arabic, powdered, four ounces;

Boiling distilled water, eight ounces.

Rub the gum with the water until it be dissolved.

MUCILAGO GUMMI ARABICI.

*Edinb.*

*Mucilage of Gum Arabic.*

Take of

Gum arabic, beat into powder, and warm water, each equal weights.

Digest, and frequently stir them till the gum be dissolved, then press the solution through linen.

MUCILAGO GUMMI TRAGACANTHÆ.

*Edinb.*

*Mucilage of Gum Tragacanth.*

Take of

Gum tragacanth, powdered, one ounce;

Hot water, eight ounces.

Macerate twenty-four hours; then mix them, by rubbing briskly, that the gum may be dissolved; and press the mucilage through linen cloth.

MUCILAGO SEMINIS CYDONII MALI.

*Lond.*

*Mucilage of Quince Seed.*

Take of

Seeds of the quince, one dram;

Distilled water, eight ounces, by measure.

Boil with a slow fire until the water thickens; then pass it through linen.

The various mucilages differ little from each other but in the degrees of their tenacity; the starch is used more for clysters, the rest in the preparation of other medicines.

INFUSUM GENTIANÆ COMPOSITUM.

*Lond.*

*Compound Infusion of Gentian.*

Take of

The root of gentian, one dram;

Fresh water-rind of lemons, half an ounce;

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Dried outer-rind of Seville oranges, one dram and an half ;

Boiling water, twelve ounces, by measure.

Macerate for an hour, and strain.

This is employed in alvine fluxes of a passive nature.  
The dose is a spoonful every hour.

#### INFUSUM AMARUM.

*Edinb.*

*Bitter Infusion.*

Take of

Gentian root, half an ounce ;

Dried peel of Seville oranges, one dram ;

Coriander seeds, half a dram ;

Proof-spirit, four ounces ;

Water, one pound.

First pour on the spirit, and three hours thereafter add the water ; then macerate without heat for a night, and strain.

This is a good stomachic, and much improved by the addition of the spirit.

#### INFUSUM SENNÆ SIMPLEX.

*Lond.*

*Simple Infusion of Senna.*

Take of

Senna, an ounce and a half ;

Ginger, powdered, one dram ;

Rising distilled water, one pint.

Macerate them for one hour, in a covered vessel ; and, the liquor, being cold, strain it.

This aromatic infusion is used in an ounce or two for a dose.

#### INFUSUM SENNÆ TARTARISATUM.

*Lond.*

*Tartarised Infusion of Senna.*

Take of

Senna, one ounce and a half ;

Coriander-seeds, bruited, half an ounce ;

Crystals of tartar, two drams ;

Distilled water, one pint.

Dissolve the crystals of tartar by boiling in the water ; then pour the water, as yet boiling, on the senna and seeds. Macerate for an hour in a covered vessel, and strain when cold.

This is considered as an improvement on the former.  
The addition of the tartar preventing its griping tendency.

INFUSUM TAMARINDORUM CUM SENNA.

*Edin.*

*Infusion of Tamarinds with Senna.*

Take of

Tamarinds, six drams;  
Crystals of tartar,  
Senna, each one dram;  
Coriander seeds, half a dram;  
Red candied sugar, half an ounce;  
Boiling water, eight ounces.

Macerate in a close earthen vessel, which has not been varnished with lead. Stir the liquor now and then, and after it has stood four hours strain it. It may also be made with double, triple, &c. the quantity of senna.

This differs little from the former.

INFUSUM ROSÆ.

*L. ed.*

*Infusion of the Rose.*

Take of

Red rose-buds, the heels being cut off, half an ounce;  
Vitriolic acid, diluted, three drams;  
Boiling distilled water, two pints and a half;  
Double-refined sugar, one ounce and a half.

To the water, first poured on the petals in a glass vessel, add the diluted vitriolic acid, and macerate for half an hour. Strain the liquor when cold, and add the sugar.

This is used in active hæmorrhages as astringent.

INFUSUM *vulgo* TINCTURA ROSARUM.

*Philab.*

*Infusion commonly called Tincture of Rose.*

Take of

Red roses, dried, an ounce;  
Boiling water, five pounds;  
Vitriolic acid, one dram;  
White sugar, two ounces.

Macerate the roses with the boiling water in an unglazed vessel for four hours; then having poured on the acid, strain the liquor, and add the sugar.

INFUSUM RHEI.

*Edin.*

*Infusion of Rhubarb:*

Take of

Rhubarb, half an ounce;

Boiling water, eight ounces;

Spiritous cinnamon water, one ounce.

Macerate the rhubarb in a glass vessel with the boiling water for a night; then having added the cinnamon water, strain the liquor.

#### AQUA CALCIS.

*Lond.*

*Lime Water.*

Take of

Quicklime, half a pound;

Potting distilled water, twelve pints.

Mix, and set it aside in a covered vessel for one hour; then pour off the liquor, which keep in a close vessel.

*Edinb.*

Take half a pound of fresh-burnt quicklime, put it into an earthen vessel, and gradually sprinkle upon it four ounces of water, keeping the vessel shut whilst the lime grows hot and falls into powder. Then pour upon it twelve pounds of water, and mix the lime thoroughly with the water by stirring. After the lime has subsided renew the stirring; and let this be done about ten times, always keeping the vessel shut (during the ebullition), that the access of the air may be the more effectually prevented. Lastly, let the water be filtered through paper placed in a funnel close shut at its top; and it must be kept in very close vessels.

Lime water is much used in a variety of cases with various success, both internally and externally, particularly when the disease is connected with a predominant acid, as happens often in the complaints of women and children, as diarrhœa, leucorrhœa, diabetes, &c. It is also a useful anthelmintic and lithontriptic. It is used to the quantity of a bottle or more a day. Externally it forms a wash for gleety sores.

#### ACETUM SCILLÆ.

*Lond.*

*Vinegar of Squills.*

Take of

Squills, fresh dried, one pound;

Vinegar, six pints;

Proof-spirit, half a pint.

Macerate the squills in the vinegar, with a gentle heat, in a glass vessel, for four-and-twenty hours; then press out the liquor, and set it by that the feces may subside: lastly, pour off the liquor, and add to it the spirit.

ACETUM SCILLITICUM.

*Edm.*

*Squill Vinegar.*

Take of

- Dried root of squills, two ounces;
- Distilled vinegar, two pounds and a half;
- Rectified spirit of wine, three ounces.

Macerate the squills with the vinegar eight days; then press out the vinegar, to which add the spirit; and when the fæces have subsided, pour out the clear liquor.

Is a powerful stimulant and expectorant in dropical cases, and useful in pectoral complaints connected with a morbid secretion of viscid phlegm. It must be given in small doses.

ACETUM AROMATICUM.

*Succ.*

*Aromatic Vinegar.*

Take of

- Tops of Rosemary,
- Leaves of sage, each four ounces;
- Flowers of lavende, two ounces;
- Cloves, two drams;
- Vinegar, eight pounds.

Macerate for four hours, express the liquor, and strain it.

Is chiefly used as an antiseptic for external application.

ACETUM ROSACEUM.

*Succ.*

*Vinegar of Roses.*

Take of

- The flowers of red roses dried, any quantity; add to them twelve times their weight of vinegar.

Macerate for four days, and strain through paper.

Makes a useful external embrocation in head-ach.

ACETUM LITHARGYRI.

*Succ.*

*Vinegar of Litharge.*

Take of

- Litharge, triturated, half a pound;
- Vinegar, two pounds.

Digest them together frequently, stirring the mixture with a wooden rod, till the colour of blue paper be not changed by the vinegar; preserve for use the clear liquor which is above the sediment.

This is the same as the basis of Goulard's Lotion.



## ACETUM COLCHICI,

*Rofs.**Vinegar of Colchicum.***Take of**

The recent root of colchicum cut in slices, one ounce ;

Vinegar one pound.

Macerate with a gentle heat for two days ; then strain after slight expression.

Is a useful diuretic and expectorant in dropical cases where the squill is also proper.

## INFUSUM KINKINÆ.

*Succ.**Infusion of Peruvian Bark.***Take of**

Peruvian bark, bruised, an ounce and a half ;

Spring water, boiling, a pound and an half.

Digest for two hours, shaking the vessel frequently ; then strain the liquor with expression.

## AQUA PICEA.

*Tar Water.***Take of**

Tar, two pounds ;

Water, one gallon ;

Stir them strongly together with a wooden rod ; and after standing to settle for twelve hours, pour off the water for use.

Tar water is now little used, and is only an impregnation of water with the vegetable acid.

## DECOCTUM CATECHU.

*Gen.**Decoction of Catechu.***Take of**

Catechu, three drams ;

Spring-water, two pounds.

Boil it to one pound ; and add to the strained liquor,

Symp of gances, three ounces.

*Powders.*

The first, or simplest of these forms is that of powders, and is appropriated only to those substances that are not too volatile or bulky, or whose virtues require them to

be taken in substance. No substance, therefore, should be given in the form of powder whose dose exceeds half a dram, and the vehicle for taking them should be a thin diluent with the lighter powders, and a thick or viscid substance for the heavier or resinous ones. In the preparation of powders the rules are a careful separation of all the decayed or too rigid parts, the sprinkling the dry aromatics with a few drops of water during the operation of pulverization, and drying in a sufficient degree by a gentle heat the moiſter ones before it. The mixing difficultly pulverisable substances, as the gums, &c. with those that are easier reduced; and the making no separation of any part, till the whole pulverisation is completed. In the case of aromatics, preparing little at a time, or preserving them when powdered closely stopp'd up, for some substances, though not volatile, have their virtues impaired when long exposed to the air.

PULVIS ALOËTICUS.

*Lond.*

*Aloetic Powder.*

Take of

Socotorine aloes, one pound;  
White canella, three ounces.

Rub them separately to powder, then mix them.

Is chiefly employed in the form of electuaries, pills, or tincture.

PULVIS ALOËTICUS CUM FERRO.

*Lond.*

*Aloetic Powder with Iron.*

Take of

Socotorine aloes, powdered, an ounce and an half;  
Myrrh, powdered, two ounces;  
Dry extract of gentian;  
Vitriolated iron, of each, in powder, one ounce.

Mix them.

This is also reduced commonly to the form of pills.

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## PULVIS ALOETICUS CUM GUAIACO.

Lond.

*Aloetic Powder with Guaiacum.*

Take of

Socotorine aloes, one ounce and an half;

Gum guaiacum, one ounce;

Aromatic powder, half an ounce.

Rub the aloes and gum guaiacum separately to powder; then mix all the ingredients together.

This is the basis of the pilulæ aromaticæ, and is a useful diaphoretic in small doses.

## PULVIS AROMATICUS.

Lond.

*Aromatic Powder.*

Take of

Cinnamon, two ounces;

Smaller cardamom seeds, husked,

Ginger,

Long pepper, of each one ounce.

Rub them together to a powder.

Is useful in cold habits as a warm stomachic, from ten grains to half a dram.

PULVIS DIAROMATON, *five SPECIES AROMATICÆ.*

Edin.

*Aromatic Powder, or, Aromatic Species.*

Take of

Nutmegs,

Lesser cardamom seeds,

Ginger, of each two ounces.

Beat them together into a powder, to be kept in a phial well shut.

## PULVIS ASARI COMPOSITUS.

Lond.

*Compound Powder of Asarabacca.*

Take of

The dry leaves of asarabacca,

Sweet marjoram,

Syrian herb-mastich,

Dry flowers of lavender, of each one ounce.

Powder them together.

This is the preparation sold as herb scum.

**PULVIS STERNATORIUS, *sive* CEPHALICUS.**

*Edin.*

*Sternutatory, or Cephalic Powder.*

Take of

The leaves of asarum, three parts ;

Marj. ram, one part.

Beat them together into a powder.

**PULVIS *c* CERUSSA.**

*Lond.*

*Powder of Cerusse.*

Take of

Cerusse, five ounces ;

Sarcocol, one ounce and a half ;

Tragacanth, half an ounce.

Rub them together into powder.

This is an external preparation employed in lotions and collyria.

**PULVIS *c* CHELIS CANCRORUM COMPOSITUS.**

*Lond.*

*Compound Powder of Crabs Claw.*

Take of

Crabs claws, prepared, one pound ;

Chalk,

Red coral, each, prepared, three ounces.

Mix them.

This is a simple absorbent powder.

**PULVIS CONTRAYERVÆ COMPOSITUS.**

*Lond.*

*Compound Powder of Contrayerva.*

Take of

Contrayerva, powdered, five ounces ;

Compound powder of crabs claws, one pound and an half.

Mix them.

This owes its virtues entirely to the contrayerva.

**PULVIS *c* CRETÆ COMPOSITUS.**

*Lond.*

*Compound Powder of Chalk.*

Take of

Prepared chalk, half a pound,

Cinnamon, four ounces ;

Tormentil,

Gum arabic, of each, three ounces ;

Long pepper, half an ounce.  
Powder them separately, and mix them.

**PULVIS CRETACEUS.**

*Edin.*

*Chalk Powder.*

Take of

White chalk prepared, four ounces;

Nutmeg, half a dram;

Cinnamon, one dram.

Mix and make them into a powder; which may supply the place of the cardiacal troches.

The junction of the aromatics renders this a useful medicine in weakness of stomach and diarrhœa from an acrid cause.

**PULVIS   CRETA COMPOSITUS CUM OPIO.**

*Lond.*

*Compound Powder of Chalk with Opium.*

Take of

Compound powder of chalk, eight ounces;

Hard purified opium, powdered, one dram and an half.

Mix them.

This renders the above still more powerful.

**PULVIS IPECACUANHÆ COMPOSITUS.**

*Lond.*

*Compound Powder of Ipecacuanha.*

Take of

Ipecacuanha,

Hard purified opium, of each, powdered, one dram;

Vitriolated kali, powdered, one ounce.

Mix them.

This is a certain sudorific in rheumatism, dropsy, and other diseases, in a dose of from five to twelve grains, avoiding drink for some time after it.

**PULVIS SUDORIFICUS, *frus* DOVERI.**

*Edin.*

*Sudorific, or Dover's Powder.*

Take of

Vitriolated tartar, three drams;

Opium,

Root of ipecacuanha, beat, of each one scruple.

Mix, and grind them accurately together, so as to make an uniform powder.

## PHARMACY.

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This in ten or twelve grains is even more certain than the former.

### PULVIS *e* JALAPA COMPOSITUS.

*Edin.*

*Compound Powder of Jalap.*

Take of

Jalap root, two ounces;

Crytals of tartar, two ounces.

Mix, and diligently grind them together for some time, so as to form a very fine powder.

This is an active purgative.

### PULVIS *e* MYRRHA COMPOSITUS.

*Lond.*

*Compound Powder of Myrrh.*

Take of

Myrrh,

Dried safin,

rue,

Russian castor, of each one ounce.

Rub them together into a powder.

This is celebrated against uterine obstructions from one scruple to a dram thrice a day.

### PULVIS OPIATUS.

*Lond.*

*Opiate Powder.*

Take of

Hard purified opium, powdered, one dram;

Burnt and prepared hartshorn, nine drams.

Mix them.

This is a sweating powder, ten grains of it contain one of opium.

### PULVIS *e* SCAMMONIO COMPOSITUS.

*Lond.*

*Compound Powder of Scammony.*

Take of

Scammony,

Hard extract of jalap, of each two ounces;

Ginger, half an ounce.

Powder them separately, and mix them.

*Edimb.*

Take of

Scammony,

Crystals of tartar, of each two ounces.  
Mix, and grind them diligently into a powder.

**PULVIS e SCAMMONIO CUM ALOE.**

*Lond.*

*Powder of Scammony with Aloes.*

Take of

Scammony, six drams;  
Hard extract of jalap,  
Socotorine aloes, of each an ounce and an half;  
Ginger, half an ounce.

Powder them separately, and mix them.

This is a more active purgative than the former. From five to ten grains are its dose.

**PULVIS e SCAMMONIO CUM CALOMELANE.**

*Lond.*

*Powder of Scammony with Calomel.*

Take of

Scammony, half an ounce;  
Calomel,  
Double-refined sugar, of each two drams.

Rub them separately to a powder, and then mix them.

This is more suited to obstinate costiveness and dropical cases.

**PULVIS e SENNA COMPOSITUS.**

*Lond.*

*Compound Powder of Senna.*

Take of

Senna,  
Crystals of tartar, of each two ounces;  
Scammony, half an ounce;  
Ginger, two drams.

Rub the scammony by itself, rub the rest together into a powder, and then mix them all.

Two scruples to a dram are the dose of this powder.

**PULVIS STYPTICUS.**

*Edin.*

*Styptic Powder.*

Take of

Alum, an ounce and a half;

Gum kino, three drams.

Grind them together into a fine powder.

This is a powerful astringent in uterine hæmorrhages.

PULVIS ꝛ TRAGACANTHA COMPOSITUS.

*Lond.*

*Compound Powder of Tragacanth.*

Take of

Tragacanth, powdered,

Gum Arabic,

Starch, of each an ounce and half.

Double-refined sugar, three ounces.

Rub them together into a powder.

This is a mild demulcent in pectoral and alvine complaints, in a dose of half a dram to three drams.

PULVIS ANTHELMINTICUS.

*Gen.*

*Anthelmintic Powders.*

Take of

The flowers of tanfy,

Worm-feed, each three drams ;

Sal martis, one dram.

Mix them.

Half a dram of this powder is a dose.

PULVIS ANTILYSSUS.

*Brun.*

*Powder against the Bite of a Mad Dog.*

Take of

Ash-coloured ground liverwort, two ounces ;

Black pepper, one ounce.

Beat them together into a powder.

PULVIS ARI COMPOSITUS.

*Succ.*

*Compound Powder of Arum.*

Take of

Arum root, fresh dried, two drams ;

Yellow water-flag roots,

Burnet saxifrage roots, each one dram ;

Canella alba, a dram ;

Salt of wormwood, one scruple.

Beat them into a powder, which is to be kept in a close vessel.



## PHARMACY.

## PULVIS DIGESTIVUS.

*Succ.**Digestive Powder.*

Take of

Bitter purging salts,  
Rhubarb, each equal parts.

Mix them.

This is a good stomachic and evacuant.

## PULVIS DYSENTERICUS.

*Dan.**Dysenteric Powder.*

Take of

Rhubarb, one ounce;  
Calcined hartshorn, half an ounce;  
Gum Arabic, three drams;  
Cascarilla bark, two drams.

Mix them, and reduce them to a very fine powder.

This is only suited to the passive stage of dysentery.

## PULVIS FUMALIS.

*Rosi.**Fumigation Powder.*

Take of

Olibanum,  
Amber,  
Mastic, each three parts;  
Storax, two parts;  
Benzoine,  
Labdanum, each one part.

Mix them into a gross powder.

This is only used for the purposes of fumigation.

## PULVIS INFANTUM.

*Succ.**Powder for Infants.*

Take of

Magnesia alba, one ounce;  
Rhubarb, reduced to a very fine powder, one dram.

Let them be mixed.

This is suited to correct the ascendent state of the stomach and bowels of infants.

**PULVIS NITROSUS.**

*Succ.*

*Nitrous Powder.*

Take of

Purified nitre, three ounces ;  
Salt of sorrel, one ounce ;  
Double refined sugar, ten ounces.

Let them be mixed.

This is a good mode of exhibiting nitre.

**PULVIS PERUVIANUS PURGANS.**

*Gen.*

*Purging Peruvian Powder.*

Take of

The powder of Peruvian bark, one ounce ;  
Powder of rhubarb,  
sal ammoniac, each one dram and a half.

This form prevents the costive tendency of the bark.

**PULVIS SEDATIVUS.**

*Succ.*

*Sedative Powder.*

Take of

Opium, half a scruple ;  
Purified nitre, five scruples and a half ;  
Refined sugar, one ounce.

**PULVIS s SPONGIA.**

*Gen.*

*Sponge Powder.*

Take of

Burnt sponge, powdered,  
Common salt, each three drams.

Mix them, and divide into twelve powders.

This is used in scrofulous cases.

*Troches.*

Troches are powders made up with glutinous substances, a form chiefly intended to allow medicines to dissolve slowly in the mouth. The same rules are to be observed here as in making powders which is the previous step. In forming them, the hands are to be anointed with oil, or sprinkled with starch or liquorice powder, to prevent adhesion. When formed, they should

be dried in an airy place on an inverted sieve, and frequently turned.

**TROCHISCI AMYLI.**

*Lond.*

*Troches of Starch.*

Take of

Starch, an ounce and a half;

Liquorice, six drams;

Florentine orris, half an ounce;

Double-refined sugar, one pound and a half.

Rub these to powder, and, by the help of tragacanth, dissolved in water, make troches.

They may be made, if so chosen, without the orris.

**TROCHISCI BECHICI ALBA.**

*Edin.*

*White Pectoral Troches.*

Take of

Purest sugar, one pound;

Gum Arabic, four ounces;

Starch, one ounce;

Flowers of benzoin, half a dram.

Having beat them all into a powder, make them into a proper mass with rose-water, so as to form troches.

**TROCHISCI GLYCYRRHIZÆ.**

*Lond.*

*Troches of Liquorice.*

Take of

Extract of liquorice,

Double refined sugar, of each ten ounces;

Tragacanth, powdered, three ounces.

Make troches by adding water.

**TROCHISCI BECHICI NIGRI.**

*Edin.*

*Black Pectoral Troches.*

Take of

Extract of liquorice,

Gum Arabic, each four ounces;

White sugar, eight ounces.

Dissolve them in warm water, and strain; then evaporate the mixture over a gentle fire till it be of a proper consistence for being formed into troches.

TRACHISCI BECHICI cum OPIO.

*Edin.*

*Pectoral Troches with Opium.*

Take of

Pure opium, two drams;  
Balsam of Peru, one dram,  
Tincture of Tolu, three drams.

Grind the opium with the balsam and tincture previously mixed, till it be thoroughly dissolved, then add by degrees,

Of

Common syrup, eight ounces,  
Extract of liquorice, softened in warm water, five ounces.

Mix by beating them diligently, gradually sprinkle upon the mixture five ounces of powdered gum Arabic. Exsiccate so as to form troches, each weighing ten grains.

TRACHISCI e NITRO.

*“ Lond.*

*Troches of Nitre.*

Take of

Purified nitre, powdered, four ounces;  
Double-refined sugar, powdered, one pound;  
Tragacanth, powdered, six ounces.

With the addition of water, make troches.

TRACHISCI e NITRO.

*“ Edin.*

*Troches of Nitre.*

Take of

Nitre purified, three ounces;  
Double refined sugar, nine ounces.

Make them into troches with mucilage of gum tragacanth.

TRACHISCI e SULPHURE.

*“ Lond.*

*Troches of Sulphur.*

Take of

Washed flowers of sulphur, two ounces,  
Double-refined sugar, four ounces

Rub them together, and, with the mucilage of quince-seeds, now and then added, make troches.

TRACHISCI e SULPHURE, five DIASULPHURIS.

*“ Edin.*

*Troches of Sulphur.*

Take of

Flowers of sulphur, two ounces,

Flowers of benzoine, one scruple ;

White sugar, four ounces ;

Facitious cinnabar, half a dram.

Beat them together, and add mucilage of gum tragacanth as much as is sufficient

Mix and make them into troches according to art.

#### TROCHISCI *e* CRETA.

*Lond.*

*Troches of Chalk.*

Take of

Chalk, prepared, four ounces ;

Crabs-claws, prepared, two ounces ;

Cinnamon, half an ounce ;

Double-refined sugar, three ounces.

These being rubbed to powder, add the mucilage of gum Arabic, and make troches.

#### TROCHISCI *e* MAGNESIA.

*Lond.*

*Troches of Magnesia.*

Take of

Burnt magnesia, four ounces ;

Double-refined sugar, two ounces ;

Ginger, powdered, one scruple.

With the addition of the mucilage of gum Arabic make troches.

#### TROCHISCI *de* MINIO.

*Dan.*

*Red Lead Troches.*

Take of

Red lead, half an ounce ;

Corrive mercury sublimate, one ounce ;

Crumbs of the finest bread, four ounces.

Make them up with rose water into oblong troches.

#### TROCHISCI CATECHU.

*Brun*

*Troches of Catechu.*

Take of

Catechu, one ounce ;

White sugar candy, two ounces ;

Ambergris,

Musk, each ten grains ;

Mucilage of gum tragacanth, as much as is sufficient.

Make them into troches.

*Pills.*

Medicines of a small dose and offensive smell and taste, are easily adapted to this form. From its difficult solution, the medical effects of this form are the most lasting, and where this is not wanted, resins and saponaceous substitutes should be joined with them to increase their solubility. Light dry powders are made up in this form, with mucilages or syrups; gums, or resins, with spirit of wine; ponderous substances with honey, conserves, or extracts.

The rules for the formation of pills are, to observe the same previous steps as in the preparation of powders. In the junction of resins, gums, or extracts, they are to be severally softened to powder, then added, and the whole beat together till fully mixed. The masses should afterwards be kept in bladders, moistened occasionally with some of the preparing solvent.

## PILULÆ ÆTHIOPICÆ.

*Edin.**Ethiopic Pills.*

Take of

Quicksilver, six drams;  
Golden sulphur of antimony,  
Resin of guaiacum,  
Honey, each half an ounce.

Grind the quicksilver with the honey, in a glass mortar, until the mercurial globules entirely disappear; then add the golden sulphur and guaiacum, with as much mucilage of gum Arabic as is sufficient to make the mixture into a mass of the proper consistence for forming pills.

They are an useful alterative both in cutaneous and venereal disorders. One fourth part of the quantity above prescribed may be made into sixty pills; of which, from one to four may be taken every night and morning, the patient keeping moderately warm during the whole time that this course is continued.

## PILULÆ ex ALOE.

*Lord.**Pills of Aloes.*

Take of

Socotorine aloes, powdered, one ounce;

Extract of gentian, half an ounce;  
 Syrup of ginger, as much as is sufficient.  
 Beat them together.

**PILULÆ ALOETICÆ.**

*Edinb.*

*Aloetic Pills.*

Take of

Socotorine aloes, in powder,

Thick extract of gentian, each two ounces.

Make them into a mass with simple syrup.

These pills have been much used as warming and stomachic laxatives: they are very well suited for the costiveness so often attendant on people of sedentary lives.

**PILULÆ ex ALOE CUM MYRRHÆ.**

*Lond.*

*Pills of Aloes with Myrrh.*

Take of

Socotorine aloes, two ounces;

Myrrh,

Saffron, of each one ounce;

Syrup of saffron, as much as is sufficient.

Rub the aloes and myrrh separately to powder; afterwards beat them all together.

**PILULÆ COMMUNES, vulgo RUFÆ.**

*Edin.*

*The Common Pills, vulgarly called Rufus's Pills.*

Take of

Socotorine aloes, two ounces;

Myrrh, one ounce;

Saffron, half an ounce.

Beat them into a mass with a proper quantity of syrup.

These pills, given to the quantity of half a dram or two scruples, prove considerably cathartic, but they answer much better purposes in smaller doses as laxatives or alteratives.

**PILULÆ ex COLOCYNTHIDE cum ALOE, vulgo**

**PILULÆ COCCINÆ.**

*Colocynth Pills with Aloes, commonly called Coccinæ.*

*Edin.*

Take of

Socotorine aloes,

Scammony, of each two ounces;  
 Sal polychrest, two drams;  
 Colocyath, one ounce;  
 Oil of cloves, two drams.

Reduce the aloes and scammony into a powder with the salt; then let the colocyath, beat into a very fine powder, and the oil be added; lastly, make it into a proper mass with mucilage of gum Arabic.

These pills often produce a copious discharge in cases of obstinate costiveness, when taken to the extent only of five or ten grains; but they may be employed in much larger doses.

PILULÆ e CUPRO.

*Edinb.*

*Copper Pills.*

Take of

Cuprum ammoniacum, sixteen grains;  
 Crumb of bread, four scruples;  
 Spirit of sal ammoniac, as much as is sufficient to form them into a mass, which is to be divided into thirty-two equal pills.

Each of these pills weighs about three grains, and contains somewhat more than half a grain of the cuprum ammoniacum.

PILULÆ e GUMMI.

*Lond.*

*Gum Pills.*

Take of

Galbanum,  
 Opopanax,  
 Myrrh,  
 Sagapenum, of each one ounce;  
 Asafœtida, half an ounce;  
 Syrup of saffron, as much as is sufficient.

Beat them together.

PILULÆ GUMMOSÆ.

*Edinb.*

*Gum Pills.*

Take of

Asafœtida,  
 Galbanum,  
 Myrrh, each one ounce;  
 Rectified oil of amber, one dram.

Beat them into a mass with simple syrup.



These pills are designed as antihysterics and emmenagoes, and are very well calculated for answering those intentions; half a scruple, a scruple, or more, may be taken every night or oftener.

PILULÆ *ex* HYDRARGYRO.

*Lond.*

*Quicksilver Pills.*

Take of

Purified quicksilver,

Extract of liquorice, having the consistence of honey, of each two drams,

Liquorice, finely powdered, one dram.

Rub the quicksilver with the extract of liquorice until the globules disappear; then, adding the liquorice-powder, mix them together.

PILULÆ *e* HYDRARGYRO, *five* MERCURIALES.

*Edinb.*

*Mercurial Pills.*

Take of

Quicksilver,

Honey, each one ounce:

Crumb of bread, two ounces,

Grind the quicksilver with the honey in a glass mortar till the globules disappear, adding occasionally a little simple syrup; then add the crumb of bread, and beat the whole with water into a mass, which is to be immediately divided into four hundred and eighty equal pills.

The mercurial pill is one of the best preparations of mercury, and may in general supersede most other forms of this medicine. The dose of the pills is from two to four or six in the day, according to the effects we wish to produce.

PILULÆ *e* JALAPPA.

*Edin.*

*Jalap Pills.*

Take of

Extract of jalap, two ounces;

Aromatic powder, half an ounce,

Beat them into a mass with simple syrup.

This is an useful and active purgative, either for evacuating the contents of the intestinal canal, or producing a discharge from the system in general.

PILULÆ PLUMMERI.

*Edinb.*

*Plumer's Pill.*

Take of

Sweet mercury,  
Precipitated sulphur of antimony, each six drams;  
Extract of gentian,  
White Spanish soap, each two drams.

Let the mercury be triturated with the sulphur till they be thoroughly mixed, then add the extract, and form a mass with simple syrup.

This is a useful alterative in five or ten grains twice a day.

PILULÆ ex OPIO.

*Lond.*

*Opium Pills.*

Take of

Hard purified opium, powdered, two drams;  
Extract of liquorice, one ounce.

Beat them until they are perfectly united.

PILULÆ THEBAICÆ, vulgo PACIFICÆ.

*Edinb.*

*Thebaic, commonly called Pacific Pills.*

Take of

Opium, half an ounce;  
Extract of liquorice, two ounces;  
Castile soap, an ounce and a half;  
Jamaica pepper, one ounce.

Soften the opium and extract separately with proof-spirit, and having beat them into a pulp, mix them; then add the soap, and the pepper beat into a powder; and lastly, having beat them well together form the whole into a mass.

The first is a simple opiate, in which every five grains of the mass contains one of opium; and on the opium alone can we suppose that the activity of the medicine depends. Nine grains of the composition contain nearly one of opium.

PILULÆ SQUILLÆ.

*Lond.*

*Squill Pills.*

Take of

Fresh dried squill, powdered, one dram;  
Ginger, powdered,

Soap, of each three drams ;  
 Ammoriacum, two drams ;  
 Syrup of ginger as much as is sufficient.  
 Beat them together.

## PILULÆ SCILLITICÆ.

*Edinb.**Squill Pills.*

Take of

Gum ammoniac,  
 Lesser cardamon seeds, in powder,  
 Extract of liquorice, each one dram ;  
 Dried root of squills, in fine powder, one scruple.  
 Mix, and form them into a mass with simple syrup.

These are elegant and commodious forms for the exhibition of squills.

## PILULÆ STOMACHICÆ.

*Edinb.**Stomachic Pills.*

Take of

Rhubarb, one ounce ;  
 Saccharine albes, six dram. ;  
 Myrrh, half an ounce ;  
 Vitriolated tartar, one dram ;  
 Essential oil of mint, half a dram ;  
 Syrup of orange peel, a sufficient quantity.  
 Make them into a mass.

A scruple of the mass may be taken twice a day.

## PILULÆ BACHLRI.

*Gen.**Bacher's Pill.*

Take of

Extract of black hellebore,  
 Purified myrrh, each one ounce ;  
 Powder of carduus benedictus, two scruples  
 Mix them into a mass according to art, to be dried in the air till it be  
 fit for the formation of pills, each weighing one grain.

The dose is varied according to circumstances, from one to thirty pills being taken in the course of the day.

PILULÆ *ex* ELATERIO.

*Succ.*

*Pills of Elaterium.*

Take of

The purest gum ammoniac, two ounces,  
Socotorine aloes,  
Gamboge, each two drams;  
Elaterium, half a dram.

Mix them, by means of bitter tincture, into a mass for the formation of pills, each weighing two grains.

This, as well as the former, is also a pill celebrated for the cure of dropical affections: and when each pill is made to contain half a grain of the elaterium, the dose may be easily accommodated to the circumstances of the patient, one or two pills being taken every hour till they begin to operate.

PILULÆ FOETIDÆ.

*Succ.*

*Fetid Pills.*

Take of

Asafœtida,  
Castor, each a dram and a half;  
Salt of amber, half a dram;  
Oil of hartshorn, half a scruple.

Make them into a mass, with tincture of myrrh, to be divided into pills of two grains each.

This is a useful nervous medicine in hysterical cases.

PILULÆ *de* GAMBOGIA.

*Dan.*

*Gamboge Pills.*

Take of

Socotorine aloes,  
Extract of black hellebore,  
Sweet mercury,  
Gamboge, each two drams;  
Distilled oil of juniper, half a dram;  
Syrup of buckthorne, as much as is sufficient for forming a mass of pills.

It is not improbable that the essential oil of juniper may in some degree operate as a corrigent.

## PILULÆ e MERCURIO CORROSIVO ALBO.

*Succ.**Pills of corrosive sublimated Mercury.*

Take of

Corrosive sublimate,

I distilled sal ammoniac, each one scruple ;

Distilled water, as much as is sufficient to melt them ;

Powder of the root of aithia, sixteen scruples ;

Honey, two drams.

Mix them into a mass for the formation of pills, each weighing three grains.

Each of the pills contains about an eighth of a grain of the corrosive ; thus the dose may be easily regulated according to the intention in view.

## PILULÆ PICEÆ.

*Dan.**Tar Pills.*

Take any quantity of tar, and mix with it as much powdered elecampane root as will reduce it to a proper thickness for being formed into pills.

Half a dram of the mass, made into middle-sized pills, is given every morning and evening in disorders of the breast, scurvy, &c.

## PILULÆ SAPONACEÆ.

*Succ.**Soap Pills.*

Take of

Hard white soap, two ounces ;

Extract of birch, one ounce.

Let them be formed into a mass, to be divided into pills, each containing three grains.

This article, even when taken in small quantity with some constitutions, operates as a gentle laxative.

## PILULÆ e STYRACE.

*Succ.**Storax Pills.*

Take of

Strained storax, five scruples ;

Extract of liquorice, three drams ;

Opium, one dram.

Let the opium, dissolved in wine, be added to the other ingredients, so as to form a mass of proper consistence, to be made into pills, each weighing three grains.

One grain of opium is contained in six grains of the mass.

*Electuaries.*

Electuaries consist generally of mild alterative powders mixed with syrup to a middling consistence, so as to admit of being easily swallowed. In making them, the proportion of honey is thrice the weight of the powder, or of syrup about twice the weight; and, to prevent the drying nature of the powder, a little conserve should be added, to preserve the composition moist.

Where the medicine is of the less agreeable kind, mucilage, instead of syrup, is occasionally employed, from being less adhesive; and it is rendered more palliative in this form by the addition of the liquorice extract. The dose of this form of medicine varies, according to its nature, from the size of a nutmeg to two or three ounces.

In the preparation for electuaries the rules respecting decoctions and powders will apply, preparatory to the ingredients being mixed. Substances entering this composition, and not pulverisable, should be first dissolved, and then the ingredients slowly added, till the whole is reduced to a uniform mass. Pulpy and astringent substances should in this form be prepared only in small quantity at a time, and their superfluous moisture exhaled before being mixed. Where such compositions dry, they may be restored to a fit consistence, by being mixed up with some sweet wine.

**ELECTUARIUM *c* CASSIA.**

*Lond.*

*Electuary of Cassia.*

Take of

The fresh extracted pulp of cassia, half a pound;

Manna, two ounces;

Pulp of tamarinds, one ounce;

Rose-syrup, half a pound.

Beat the manna, and dissolve it over a slow fire in the rose-syrup; then add the pulps; and, with a continued heat, evaporate the whole to the proper thickness of an electuary.

**ELECTUARIUM *e* CASSIA, *vulgo* DIACASSIA.**

*Edinb.*

*Electuary of Cassia, commonly called Diacassia.*

Take of

Pulp of cassia fistularis, six ounces;

Pulp of tamarinds,

Manna, each an ounce and a half;

Syrup of pale roses, six ounces;

Having beat the manna in a mortar, dissolve it with a gentle heat in the syrup; then add the pulps, and evaporate them with a regularly continued heat to the consistence of an electuary.

They are usefully taken by themselves, to the quantity of two or three drams occasionally, for gently loosening the belly in costive habits.

**ELECTUARIUM *e* SCAMMONIO.**

*Lond.*

*Electuary of Scammony.*

Take of

Scammony, in powder, one ounce and an half;

Cloves,

Ginger, of each six drams;

Essential oil of caraway, half a dram;

Syrup of roses, as much as is sufficient.

Mix the spices, powdered together, with the syrup; then add the scammony, and lastly the oil of caraway.

A dram and half of this, which contains fifteen grains of scammony, is equivalent to half an ounce of the other.

**ELECTUARIUM *e* SENNA.**

*Lond.*

*Electuary of Senna.*

Take of

Senna, eight ounces;

Figs, one pound;

Pulp of tamarinds,

— of cassia,

— of prunes, of each half a pound;

Coriander-seeds, four ounces;

Liquorice, three ounces;

Double-refined sugar, two pounds and an half.

Powder the fenna with the coriander-seeds, and sift out ten ounces of the mixt powder. Boil the remainder with the figs and liquorice, in four pints of distilled water, to one half; then press out and strain the liquor. Evaporate this strained liquor to the weight of about a pound and an half; then add the sugar, and make a syrup; add this syrup by degrees to the pulps, and lastly mix in the powder.

ELECTUARIUM LENITIVUM.

*Edinb.*

*Lenitive Electuary.*

Take of

Pulp of French prunes, one pound;

Pulp of cassia,

Pulp of tamarinds, each two ounces and a half;

Black syrup of sugar, commonly called molasses, one pound and a half;

Senna leaves in fine powder, four ounces.

Coriander seeds in fine powder, half an ounce.

Having boiled the pulps with the syrup to the consistence of honey, add the powders, and beat the whole into an electuary.

This electuary is a very convenient laxative, and has long been in common use among practitioners. Taken to the quantity of a nutmeg, or more, as occasion may require.

ELECTUARIUM JAPONICUM, *vulgo* CONFECTIO JAPONICA.

*Edinb.*

*Japanic Electuary, commonly called Japanic Confection.*

Take of

Japan earth, four ounces;

Gum kino, three ounces;

Cinnamon,

Nutmeg, each one ounce;

Opium diffused in a sufficient quantity of Spanish white wine, one dram and a half;

Syrup of dried roses boiled to the consistence of honey, two pounds and a quarter.

Mix, and form them into an electuary.

ELECTUARIUM JOVIALE.

*Brun.*

*Tin Electuary.*

Take of

Pure tin,

Quicksilver, each one ounce.

E c



Let them be formed into an amalgam ; then add

Oyster shells, prepared, one ounce.

Reduce the whole to a powder.

Take of

This powder,

Conserve of wormwood, each one ounce, and form an electuary with  
sy-rup of mint.

It may be taken twice a day, to the extent of two or three drams for a dose.

#### ELECTUARIUM GINGIVALIS.

*Succ.*

*Electuary for the Gums.*

Take of

Powdered myrrh, three drams ;

Cream of tartar,

Cochineal, each a dram and a half.

Grind them together in a glass mortar ; then add

Melted honey, four ounces ;

Cloves, in powder, one dram.

Myrrh, particularly under the form of tincture, has long been a favourite application to the gums, when in a spongy or ulcerated state.

#### ELECTUARIUM e MANNA.

*Succ.*

*Electuary of Manna.*

Take of

Manna,

Refined sugar, pounded,

Fennel-water, each two ounces.

Strain the mixture, using expression ; then add

Fine powder of the root of florentine orris, one dram ;

Fresh drawn almond oil, one ounce.

In this electuary we have a gentle emollient laxative, which is very useful in these cases, where constipation either arises from indurated feces, or is supported by that cause,

#### ELECTUARIUM NITROSUM.

*Gen.*

*Nitrous Electuary.*

Take of

Purified nitre, half an ounce ;

Conserve of roses, four ounces.  
Mix them.

Under this formula nitre may be introduced to a considerable extent, without giving uneasiness at the stomach, while at the same time its refrigerant power is combined with the astringency of the roses.

ELECTUARIUM TEREBINTHINATUM.

*Succ.*

*Terebinthinate Electuary.*

Take of

Spirit of turpentine, half an ounce;

Honey, one ounce;

Powder of liquorice, as much as is sufficient for the formation of an electuary.

It has been especially celebrated for the cure of obstinate rheumatisms, and above all, for that modification of rheumatism which has the name of *ischias*, and which is found, in many instances, obstinately to resist other modes of cure.

LINCTUS LENIENS.

*Succ.*

*Lenient Linctus.*

Take of

Gum arabic, bruised, two drams;

Cherry water, half an ounce.

By trituration in a mortar, mix with them

Almond oil, fresh drawn,

Syrup of almonds, each seven ounces.

It may be taken at pleasure to any extent that the stomach will easily bear.

*Confections.*

This form differs nothing from the former but in possessing somewhat more consistence.

CONFECTIO AROMATICA.

*Lond.*

*Aromatic Confection.*

Take of

Zedoary, in coarse powder,

Saffron, of each half an ounce;

Distilled water, three pints.

Macerate for twenty-four hours; then press and strain. Reduce the strained liquor, by evaporation to a pint and a half, to which add the following, rubbed to a very fine powder:

Compound powder of crabs-claws, sixteen ounces;  
Cinnamon,  
Nutmegs, of each two ounces;  
Cloves, one ounce;  
Small or cardamom-seeds, husked, half an ounce;  
Double-refined sugar, two pounds.

Make a confection.

This confection, as now reformed, is a sufficiently grateful and moderately warm cordial; and frequently given with that intention, from eight or ten grains to a scruple or upwards, in boluses and draughts.

#### ELECTUARIUM CARDIACUM, *vulga* CONFECTIO CARDIACA.

*Edinb.*

*Cordial Electuary, commonly called Cordial Confection.*

Take of

Conserve of orange-peel, three ounces;  
Preserved nutmegs, an ounce and an half;  
Preserved ginger, six drams;  
Cinnamon, in fine powder, half an ounce;  
Syrup of orange-peel, as much as will form the whole into an electuary.

We therefore consider this preparation as an useful remedy for the purposes expressed in its title.

#### CONFECTIO OPIATA.

*Lond.*

*Confection of Opium.*

Take of

Hard purified opium, powdered, six drams;  
Long pepper,  
Ginger,  
Caraway seeds, of each two ounces;  
Syrup of white poppy, boiled to the consistence of honey, three times the weight of the whole.

Mix the purified opium carefully with the heated syrup: then add the rest, rubbed to powder.

#### ELECTUARIUM THEBAICUM.

*Edin.*

*Thebaic Electuary.*

Take of

Powder of aromatics, six ounces;

Virginian snake-root, in fine powder, three ounces;  
Opium, diffused in a sufficient quantity of Spanish white-wine,  
three drams;

Clarified honey, thrice the weight of the powders.

Mix them, and form an electuary.

With regard to the quantity of opium in the foregoing compositions, one grain of it is contained in thirty-six grains of the confectio opiata, and in five scruples of the Thebaic electuary.

*Syrups.*

Syrups are solutions of sugar in simple water, or in watery and vinous infusions, and they are chiefly now employed as vehicles for medicines of greater efficacy, few of them being prescribed as medicines themselves. In making syrups the general rule is to use 29 ounces of sugar to one pint of liquor, dissolving it in the liquor in a water-bath; and, being set aside for 24 hours it is to be scummed, and the syrup poured off from the sediment.

The same rules are proper here as laid down for the simple decoctions, and the purest sugar should only be employed in making the syrup. The proportion used should be as much as the liquor can keep dissolved when cold, unless otherwise ordered. The vessel for making it should be well tinned, and the syrup when made set by till next day, and then the saccharine crust removed from it.

SYRUPUS ACETI.

*Edin.*

*Syrup of Vinegar.*

Take of

Vinegar, two pounds and an half;

Refined sugar, three pounds and an half;

Boil them till a syrup be formed.

This is to be considered as simple syrup merely acidulated, and is by no means unpleasant.

SYRUPUS ALTHÆÆ,

*Lon.*

*Syrup of Marshmallows.*

Take of

Fresh root of marshmallow, bruised, one pound;

Double refined sugar, four pounds ;

Distilled water, one gallon.

Boil the water with the marshmallow root to one half, and press out the liquor when cold. Set it by twelve hours ; and after the feces have subsided, pour off the liquor. Add the sugar, and boil it to the weight of six pounds.

*Edin.*

Take of

Marshmallow roots, somewhat dried, nine ounces ;

Water, ten pounds ;

Purest sugar, four pounds.

Boil the water with the roots to the consumption of one half, and strain the liquor, strongly expressing it. Suffer the strained liquor to rest till the feces have subsided ; and when it is free of the dregs, add the sugar ; then boil so as to make a syrup.

It is used chiefly in nephritic cases, for sweetening emollient decoctions, and the like : of itself it can do little service, notwithstanding the high opinion which some have entertained of it.

#### SYRUPUS CARYOPHYLLI RUBRI.

*Lond.*

*Syrup of Clove July-Flower.*

Take of

Fresh clove July flowers, the heels being cut off, two pounds ;

Boiling distilled water, six pints.

Macerate the flowers for twelve hours in a glass vessel ; and, in the strained liquor, dissolve the double-refined sugar, that it may be made a syrup.

#### SYRUPUS CARYOPHYLLORUM.

*Edin.*

*Syrup of Clove July-Flower.*

Take of

Clove July-flowers, fresh gathered and freed from the heels, one pound ;

Purest sugar, seven pounds and a quarter ;

Boiling water, four pounds.

Macerate the flowers in the water for a night ; then to the strained liquor add the sugar previously beat, and dissolve it by a gentle heat, to make the whole into a syrup.

This syrup is of an agreeable flavour, and of a fine red colour ; and for these it is chiefly valued.

SYRUPUS COLCHICI.

*Edin.*

*Syrup of Colchicum.*

Take of

Colchicum root, fresh and succulent, cut into small pieces, one ounce;

Vinegar, sixteen ounces;

Purest sugar, twenty-six ounces.

Macerate the root in the vinegar two days, now and then shaking the vessel; then strain it with a gentle pressure. To the strained liquor add the sugar, and boil a little so as to form a syrup.

The syrup of colchicum is often successfully employed as a diuretic, and may be taken from a dram or two to the extent of an ounce or more.

SYRUPUS CORTICIS AURANTII.

*Lond.*

*Syrup of Orange-peel.*

Take of

Fresh outer-rind of Seville oranges, eight ounces;

Boiling distilled water, five pints.

Macerate for twelve hours in a close vessel; and, in the strained liquor, dissolve the double-refined sugar to make a syrup.

*Edin.*

Take of

Yellow rind of Seville orange-peel, fresh, six ounces;

Boiling water, three pounds.

Infuse them for a night in a close vessel; then strain the liquor; let it stand to settle; and having poured it off clear from the sediment, dissolve in it four pounds and a quarter of white sugar, so as to make it into a syrup with a gentle heat.

In making this syrup it is particularly necessary that the sugar be previously powdered, and dissolved in the infusion with as gentle a heat as possible, to prevent the exhalation of the volatile parts of the peel.

SYRUPUS CROCI.

*Lond.*

*Syrup of Saffron.*

Take of

Saffron, one ounce;

Boiling distilled water, one pint.

Macerate the saffron in the water, for twelve hours, in a close vessel; and dissolve the double-refined sugar in the strained liquor that it may be made a syrup.

This syrup is at present frequently prescribed ; it is a pleasant cordial, and gives a fine colour to juleps.

**SYRUPUS SUCCI LIMONIS.**

*Lond.*

*Syrup of Lemon-juice.*

Take of

Lemon-juice, strained, after the feces have subsided, two pints ;

Double-refined sugar, fifty ounces.

Dissolve the sugar, that it may be made a syrup.

**SYRUPUS ꝛ SUCCO MALORUM LIMONIORUM.**

*Edin.*

*Syrup of Lemon-juice.*

Take of

Juice of lemons, suffered to stand till the feces have subsided, and afterwards strained, two pounds and a half.

Double refined sugar, fifty ounces.

Dissolve the sugar in the juice, so as to make a syrup thereof.

**SYRUPUS FRUCTUS MORI.**

*Lond.*

*Syrup of the Juice of Mulberries.*

**SYRUPUS FRUCTUS RUBI IDÆI.**

*Lond.*

*Syrup of the Juice of Raspberries.*

**SYRUPUS FRUCTUS RIBIS NIGRI.**

*Lond.*

*Syrup of Black Currants.*

These three are directed by the London college to be prepared in the same manner as syrup of lemons, which immediately precedes them.

All these four are very pleasant cooling syrups ; and with this intention are occasionally made use of in draughts and juleps, for quenching thirst, abating heat, &c. in bilious or inflammatory distempers. They are sometimes likewise employed in gargarisms for inflammations of the mouth and tonsils.

**SYRUPUS PAPAVERIS ALBI.**

*Lond.*

*Syrup of the White Poppy.*

Take of

The heads of white poppies, dried, and the seeds taken out, three pounds and an half ;

Double-refined sugar, six pounds ;

Distilled water, eight gallons.

Slice and bruise the heads, then boil them in the water to three gallons, in a water-bath saturated with sea-salt, and press out the liquor. Reduce this by boiling to about the measure of four pints, and strain it whilst it is hot, first through a sieve, then through a thin woollen cloth, and set it aside for twelve hours, that the feces may subside. Boil the liquor, poured off from the feces, to three pints, and dissolve the sugar in it that it may be made a syrup.

SYRUPUS PAPAVERIS ALBI, *feu de* MECONIO, *vulgo*  
DIACODION.

*Edin.*

*Syrup of White Poppies, or of Meconium, commonly called Diacodium.*

Take of

White poppy heads, dried, and freed from the seeds, two pounds ;

Boiling water, thirty pounds ;

Purest sugar, four pounds.

Macerate the bruited heads in the water for a night ; next boil till only one third part of the liquor remain ; then strain it ; expressing it strongly. Boil the strained liquor to the consumption of one half, and strain again ; lastly, add the sugar, and boil to a syrup.

It may also be made by dissolving in two pounds and a half of simple syrup, one dram of the extract of white poppies.

This syrup, impregnated with the opiate matter of the poppy heads, is given to children in doses of two or three drams ; to adults, from half an ounce to an ounce and upwards, for easing pain and procuring rest.

SYRUPUS PAPAVERIS ERRATICI.

*Lond.*

*Syrup of the Red Poppy.*

Take of

The fresh flowers of the wild, or red, poppy, four pounds ;

Boiling distilled water, four pints and an half.

Put the flowers, by degrees, into the boiling water, in a water-bath, constantly stirring them. After this, the vessel being taken out of the bath, macerate for twelve hours ; then press out the liquor, and set it apart, that the feces may subside. Lastly, make it into a syrup, with double-refined sugar.

This syrup has been recommended in disorders of the breast, coughs, spitting of blood, pleurifies, and other diseases, both as an emollient and as an opiate.



## SYRUPUS ROSÆ.

*Lond.**Rose-Syrup.*

Take of

The dried petals of the damask rose, seven ounces ;

Double-refined sugar, six pounds ;

Boiling distilled water, four pints.

Macerate the petals of the rose in water for twelve hours, and strain.

Evaporate the strained liquor to two pints and an half, and add the sugar, that it may be made a syrup.

## SYRUPUS ROSARUM PALLIDARUM.

*Edin.**Syrup of Pale Roses.*

Take of

Pale roses, fresh gathered, one pound ;

Boiling water, four pounds ;

White sugar, three pounds.

Macerate the roses in the water for a night ; then to the liquor strained, and freed from the dregs, add the sugar ; boil them into a syrup.

This syrup may likewise be made from the liquor remaining after the distillation of rose-water, depurated from its feces.

This syrup is an agreeable and mild purgative for children, in the dose of half a spoonful, or a spoonful. It likewise proves gently laxative to adults ; and with this intention may be of service in costive habits.

## SYRUPUS e ROSIS SICCIS.

*Edin.**Syrup of Dry Roses.*

Take of

Red roses, dried, seven ounces ;

White sugar, six pounds ;

Boiling water, five pints.

Infuse the roses in the water for a night, then boil them a little ; strain out the liquor, and adding to it the sugar, boil them to the consistence of a syrup.

This syrup is supposed to be mildly astringent : but is principally valued on account of its red colour.

## SYRUPUS SCILLITICUS.

*Edin.**Syrup of Squills.*

Take of

Vinegar of squills, two pounds ;

White sugar, three pounds and a half.  
Make them into a syrup with a gentle heat.

This syrup is used chiefly in doses of a spoonful or two, for promoting expectoration, which it does very powerfully.

SYRUPUS SIMPLEX, *five* COMMUNIS.

*Edin.*

*Simple or Common Syrup.*

Take of

Purest sugar, fifteen parts;

Water, eight parts.

Let the sugar be dissolved by a gentle heat.

This preparation is a plain liquid sweet, void of flavour or colour.

SYRUPUS SPINÆ CERVINÆ.

*Lon.*

*Syrup of Buckthorn.*

Take of

The juice of ripe and fresh buckthorn berries, one gallon;

Ginger, bruised, one ounce;

All-spice, powdered, one ounce and an half;

Double-refined sugar, seven pounds.

Set by the juice for some days, that the feces may subside, and strain.

Macerate the ginger and all-spice in a pint of the strained juice, for four hours, and strain. Boil away the rest of the juice to three pints; then add that part of the juice in which the ginger and all-spice have been macerated; and, lastly, the sugar, that it may be made a syrup.

SYRUPUS *e* RHAMNO CATHARTICO *seu e* SPINA  
CERVINA.

*Edin.*

*Syrup of Buckthorn.*

Take of

The juice of ripe buckthorn berries, depurated, seven pounds and a half;

White sugar, three pounds and a half.

Boil them to the consistence of a syrup.

Both these preparations, in doses of three or four spoonfuls, operate as brisk cathartics.

## SYRUPUS TOLUTANUS.

 *Lond.**Syrup of Balsam of Tolu.***Take of**

The balsam of Tolu, eight ounces;

Distilled water, three pints.

**Boil** for two hours. Mix with the liquor, strained after it is cold, the double refined sugar, that it may be made a syrup.

## SYRUPUS BALSAMICUS.

 *Edinb.**Balsamic Syrup.***Take of**

The syrup of sugar, just made, and warm from the fire, two pounds;

Tincture of the balsam of Tolu, one ounce.

**When** the syrup has grown almost cold, stir into it the tincture, by little at a time, agitating them well together, till perfectly united.**These syrups are both moderately impregnated with the agreeable flavour of the balsam.**

## SYRUPUS VIOLÆ.

 *Lond.**Syrup of Violets.***Take of**

The fresh petals of the violet, two pounds;

Boiling distilled water, five pints.

**Macerate** for twenty-four hours; afterwards strain the liquor, without pressing, through thin linen. Add refined sugar, that it may be made a syrup.

## SYRUPUS VIOLARUM.

 *Edinb.**Syrup of Violets.***Take of**

Fresh violets, one pound;

Boiling water, four pounds;

Purest sugar, seven pounds and a half.

**Macerate** the violets in the water for twenty-four hours in a glass, or at least a glazed earthen vessel, close covered; then strain without expression, and to the strained liquor add the sugar, beat and make into a syrup.**This syrup is of a very agreeable flavour; and in the quantity of a spoonful or two proves to children gently laxative.**

SYRUPUS ZINGIBERIS.

*Lond.*

*Syrup of Ginger.*

Take of

Ginger bruised, four ounces ;

Boiling distilled water, three pints.

Macerate for four hours, and strain ; then add the refined sugar, that it may be made a syrup.

*Edinb.*

Take of

Beat ginger, three ounces ;

Boiling water, four pounds ;

Purest sugar, seven pounds and a half.

Macerate the ginger in the water in a close vessel for twenty-four hours ; then to the liquor strained, and freed from the feces, add the beat sugar, and make them into a syrup.

These are agreeable and moderately aromatic syrups, lightly impregnated with the flavour and virtues of the ginger.

SYRUPUS ACIDUS.

*Gen.*

*Acid Syrup.*

Take of

Weak spirit of vitriol, two drams ;

Syrup of lemon, six ounces.

Mix them.

Where we wish to obtain a syrup, not only strongly acidulated, but also powerfully astringent, this formula may be considered as well suited to answer the purpose.

SYRUPUS ALKALINUS.

*Gen.*

*Alkaline Syrup.*

Take of

Salt of tartar, three drams.

Simple syrup, six ounces.

Mix them.

This syrup may be usefully employed either for the destruction of acid in the stomach, or for the formation of neutral or effervescent mixtures.

## SYRUPUS ALLII.

*Succ.**Syrup of Garlic.*

Take of

The fresh root of garlic, sliced, one pound;

Boiling water, two pounds.

Macerate them in a close vessel for an hour; add to the strained liquor,

Refined sugar, two pounds.

Boil them to a syrup.

This syrup is recommended for promoting expectoration in cases of chronic catarrh, and other affections of the breast.

## SYRUPUS AMYGDALINUS.

*Succ.**Syrup of Almonds.*

Take of

Sweet almonds, one pound;

Bitter almonds, two drams.

Let the almonds be blanched and beat in a stone mortar with a wooden pestle; then by degrees add barley-water, two pounds; strain the liquor, and form it into a syrup, with as much double-refined sugar as may be necessary.

The agreeable flavour of the almonds, is in this formula communicated to a syrup, which may be advantageously employed to sweeten mixtures, or to form a pleasant drink when diffused in water.

## SYRUPUS CINNAMONI.

*Rfs.**Syrup of Cinnamon.*

Take of

Cinnamon, bruised, five ounces;

Spirituuous cinnamon-water, two pounds.

Digest them in a close glass vessel for twenty-four hours; then add to the strained liquor double-refined sugar, three pounds; boil it to a syrup.

This syrup is strongly impregnated with the cinnamon; and it is proper where we wish to sweeten any mixture, at the same time adding to it an agreeable aromatic.

## SYRUPUS EMETICUS.

*Brun.**Emetic Syrup.*

Take of

Glass of antimony, finely powdered, two drams;

Rhenish wine, twelve ounces.

Let them be digested for three days in a gentle heat, then strain the liquor through paper, and mix with the strained liquor thirty ounces of double-refined sugar. Let it be formed into a syrup, and kept in a close vessel.

There can be no doubt of this syrup being strongly impregnated with the emetic quality of the antimony.

SYRUPUS HYDRARGYRI.

*Succ.*

*Syrup of Quicksilver.*

Take of

Purified quicksilver, one dram;

Gum arabic, three drams;

Rose-water, as much as is sufficient for reducing the gum to a mucus.

Let them be rubbed in a mortar till the quicksilver totally disappears; then by degrees mix it with simple syrup four ounces.

In this we have a preparation similar to the mercurial solution of Dr. Plenck, formerly mentioned.

*Medicated Honeys.*

Honeys differ little from the syrups: they are made by mixing the vegetable decoction or infusion in honey, and boiling them till the honey is reduced to its original consistence. Honey, however, being a particular substance, and liable often to produce morbid effects on the stomach and bowels, and also to pass readily into fermentation, this form is not so useful as the former.

MEL ROSÆ.

*Lond.*

*Honey of Roses.*

Take of

Red rose-buds, with the heels cut off and dried, four ounces;

Distilled water, boiling, three pints;

Clarified honey, five pounds.

Macerate the rose-petals in the water for six hours; then mix the honey with the strained liquor, and boil the mixture to the thickness of a syrup.

This preparation is not unfrequently made use of as a mild, cooling detergent, particularly in gargarisms, for ulcerations of the mouth and tonsils.

## MEL SCILLÆ.

 *Lond.**Honey of Squills.*

Take of

Clarified honey, three pounds ;

Tincture of squills, two pints.

Boil them in a glass vessel to the thickness of a syrup.

The honey will here be impregnated with all the active parts of the squills.

## OXYMEL ÆRUGINIS.

 *Lond.**Oxymel of Verdigris.*

Take of

Prepared verdigris, one ounce ;

Vinegar, seven ounces ;

Clarified honey, fourteen ounces.

Dissolve the verdigris in the vinegar, and strain it through linen ; then add the honey, and boil the whole to a proper thickness.

This is used only externally for cleansing foul ulcers, and keeping down fungous flesh.

## OXYMEL COLCHICI.

 *Lond.**Oxymel of Meadow Saffron.*

Take of

The fresh root of meadow saffron, cut into thin slices, one ounce ;

Distilled vinegar, one pint ;

Clarified honey, two pounds.

Macerate the root of meadow-saffron with the vinegar, in a glass vessel, with a gentle heat, for forty-eight hours. Strain the liquor, pressed out strongly from the root, and add the honey. Lastly, boil the mixture, frequently stirring it with a wooden spoon, to the thickness of a syrup.

This oxymel may be considered as very analogous to the syrupus colchici.

## OXYMEL SCILLÆ.

 *Lond.**Oxymel of Squill.*

Take of

Clarified honey, three pounds ;

Vinegar of squill, two pints.

Boil them in a glass vessel, with a slow fire, to the thickness of a syrup.

Oxymel of squills is an useful aperient, detergent, and expectorant, and of great service in humoral asthmas, coughs, and other disorders where thick phlegm abounds. It is given in doses of two or three drams, along with some aromatic water.

OXYMEL SIMPLEX.

*Lond.*

*Simple Oxymel.*

Take of

Clarified honey, two pounds;

Distilled vinegar, one pint.

Boil them in a glass-vessel, with a slow fire, to the thickness of a syrup.

This is an agreeable, mild, cooling medicine. It is often used in cooling, detergent gargarisms, and not unfrequently as an expectorant.

OXYMEL ex ALLIO.

*Dan.*

*Oxymel of Garlic.*

Take of

Garlic, cut in slices, an ounce and a half;

Caraway seeds,

Sweet fennel seeds, each two drams;

Clarified honey, ten ounces;

Vinegar, half a pint.

Boil the vinegar for a little time with the seeds bruised, in a glazed earthen vessel; then add the garlic, and cover the vessel close; when grown cold, press out the liquor, and dissolve in it the honey by the heat of a water-bath.

This oxymel is recommended for attenuating viscid juices, promoting expectoration, and the fluid secretions in general.

OXYMEL PECTORALE.

*Brun.*

*Pectoral Oxymel.*

Take of

Elecampane roots, one ounce;

Florence orris roots, half an ounce;

Gum ammoniacum, one ounce;

Vinegar, half a pint;

Clarified honey, one pound;

Water, three pints.



Let the roots, cut and bruised, be boiled in the water till one-third is wasted; then strain off the liquor; let it stand to settle; and having poured it off clear from the feces, add to it the honey and the ammoniacum, previously dissolved in the vinegar. Mix them together, by boiling them a little.

This composition is designed for those disorders of the breast that proceed from a load of viscid phlegm and obstruction of the pulmonary vessels. Two or three spoonfuls may be taken every night and morning, and continued for some time.

### *Medicated Wines.*

Wines are employed as a more agreeable menstruum than spirits, for extracting the medical virtues of various substances; and though objections arise, from their being rather less active, yet in some cases, from their proportion of acid they form powerful solvents, where metallic substances are dissolved in them. When the preparation with wine is finished and strained, an addition of  $\frac{1}{10}$  part of proof spirit should be added, to prevent fermentation, and the air excluded from the vessel.

#### VINUM ALOES.

*Lond.*

*Wine of Aloes.*

Take of

- Socotorine aloes, eight ounces;
- White canella, commonly called Winter's bark, two ounces;
- Spanish white-wine, six pints;
- Proof-spirit of wine, two pints.

Powder the aloes and white canella separately; when mixed, pour on them the wine: afterwards digest for fourteen days, now and then shaking them; lastly, strain.

It will not be amiss to mix white sand, cleansed from impurities, with the powder, in order to prevent the moistened aloes from getting into lumps.

#### VINUM ALOETICUM, *vulgo* TINCTURA SACRA.

*Edinb.*

*Aloetic Wine, commonly called Sacred Tincture.*

Take of

- Socotorine aloes, one ounce;
- Lesser cardamom seeds,

Ginger, each one dram ;  
 Spanish white wine, two pounds.  
 Digest for seven days, stirring now and then, and afterwards strain.

The *tinctura sacra* appears from long experience to be a medicine of excellent service. The dose, as a purgative, is from one to two ounces.

# VINUM AMARUM, *five* GENTIANÆ COMPOSITUM.

*Edinb.*

*Bitter Wine, or Compound Gentian Wine.*

Take of

Gentian root, half an ounce ;  
 Peruvian bark, one ounce ;  
 Seville orange-peel, dried, two drams ;  
 Canella alba, one dram ;  
 Proof spirit, four ounces ;  
 Spanish white wine, two pounds and a half.  
 First pour on the spirit, and after twenty-four hours add the wine ; then macerate for three days, and strain.

This wine is intended to supply the place of the *tinctura ad stomachicos*, as it was formerly called.

# VINUM ANTIMONII.

*Lond.*

*Wine of Antimony.*

Take of

Vitrified antimony, powdered, one ounce ;  
 Spanish white wine, a pint and an half.  
 Digest for twelve days, frequently shaking the vessel, and filter the wine through paper.

The antimonial wine possesses the whole virtues of that mineral, and may be so dosed and managed as to perform all that can be effected by any antimonial preparation. From ten to fifty or sixty drops, generally act as an alterative and diaphoretic ; larger doses act as a diuretic and cathartic, while three or four drams prove for the most part violently emetic.

# VINUM ANTIMONII TARTARISATI.

*Lond.*

*Wine of Tartarised Antimony.*

Take of

Tartarised antimony, two scruples ;

Boiling distilled water, two ounces;  
 Spanish white wine, eight ounces.  
 Dissolve the tartarised antimony in the boiling distilled water, and add  
 the wine.

VINUM ANTIMONII TARTARISATI, *vulgo* VINUM  
 ANTIMONIALE.

*Edinb.*

*Wine of Tartarised Antimony, commonly called Antimonial Wine.*

Take of

Tartarised antimony, twenty-four grains;  
 Spanish white wine, one pound.

Mix them so as that the antimony may be dissolved.

Each ounce of this wine contains two grains of the tar-  
 tarised antimony.

VINUM FERRI.

*Ind.*

*Wine of Iron.*

Take of

Iron filings, four ounces;  
 Spanish white wine, four pints.

Digest for a month, often shaking the vessel, and then strain.

Steel wine, as it was formerly called, is a very useful  
 preparation of this metal, and frequently exhibited in  
 chlorotic and other indispositions where chalybeates are  
 proper. The dose is from a dram to half an ounce;  
 which may be repeated twice or thrice a day.

VINUM IPECACUANHÆ.

*Ind.*

*Wine of Ipecacuanha.*

Take of

The root of ipecacuanha, bruised, two ounces;  
 Spanish white wine, two pints.

Digest for ten days, and strain.

VINUM, *vulgo* TINCTURA IPECACUANHÆ.

*Edinb.*

*Wine, commonly called Tincture of Ipecacuanha.*

Take of

Ipecacuanha, in powder, one ounce;  
 Spanish white wine, fifteen ounces.

After three days mix

Both these wines are very mild and safe emetics, and equally serviceable in dysenteries, with the ipecacuanha in substance. The common dose is an ounce, more or less, according to the age and strength of the patient.

VINUM RHABARBARI.

*Lond.*

*Wine of Rhubarb.*

Take of

Sliced rhubarb, two ounces and an half ;  
Latter cardamom-seeds, bruised and husked, half an ounce ;  
Saffron, two drams ;  
Spanish white wine, two pints ;  
Proof spirit, half a pint.

Digest for ten days, and strain.

VINUM RHEI.

*Edinb.*

*Rhubarb Wine.*

Take of

Rhubarb, two ounces ;  
Cinnamon-ba, one dram ;  
Proof spirit, two ounces ;  
Spanish white wine, fifteen ounces.

Macerate for seven days, and strain.

This is a warm, cordial, laxative medicine. It is used chiefly in weaknets of the stomach and bowels, and some kinds of loosesties, for evacuating the offending matter, and strengthening the tone of the viscera. It may be given in doses of from half a spoonful to three or four spoonfuls or more, according to the circumstances of the disorder.

VINUM NICOTIANÆ.

*Edinb.*

*Tobacco Wine.*

Take of

The dried leaves of the best Virginian tobacco, one ounce ;  
Spanish white wine, one pound.

Macerate for four days, and then strain the liquor.

This wine is a very useful remedy in the cure of dropsies and dysurises.

## VINUM SCILLITICUM.

*Squill Wine.*

Take of

Dried squill, sliced, one ounce ;

Ginger, one dram ;

French white wine, two pounds.

Macerate for three days, and then strain.

By the wine employed as a menstruum, the active properties of the squills may be readily extracted : and in some cases at least the present formula may justly be considered as entitled to a preference over either the acetum, or oxymel scillæ.

*Tinctures.*

Rectified spirit is the most complete solvent of vegetable matter, in the form of oil, resins, or sugar ; and of the parts of animals which possess a peculiar taste and taste. Its solution consists of their active parts in their pure state, which renders it preferable to water ; and as their colours are communicated to it in the most concentrated manner. These colours may be heightened by the addition of fixed alkali, though it is apt to injure the quality of the medicine. The solvent power of spirit is increased by volatile alkali, but is destroyed by acids, unless when changed to the dulcified form.

## TINCTURA ALOES.

*London. Edin.**Tincture of Aloe.*

Take of

Socotorine aloes, powdered, half an ounce ;

Extract of liquorice, an ounce and an half ;

Distilled water,

Proof spirit, of each eight ounces

Digest in a sand-bath, now and then shaking the vessel, until the extract be dissolved ; and then strain.

In cases where we wish for the operation of the aloes alone, this is perhaps one of our best formulæ under

TINCTURA ALOES COMPOSITA.

*Lond.*

*Compound Tincture of Aloes.*

Take of

Socotrine aloes,  
Saffron, of each three ounces;  
Tincture of myrrh, two pints  
Digest for eight days; and strain.

TINCTURA ALOES CUM MYRRHA, *vulgo* ELIXIR PROPRIETATIS.

*Edinb.*

*Tincture of Aloes with Myrrh, commonly called Elixir Proprietatis.*

Take of

Myrrh in powder, two ounces;  
Socotrine aloes, an ounce and a half;  
English saffron, one ounce;  
Rectified spirit of wine,  
Proof-spirit, of each one pound.

Digest the myrrh with the spirits for the space of four days; then add the aloes in powder, and the saffron; continue the digestion for two days longer, suffer the feces to subside, and pour off the clear liquor.

This medicine is highly recommended, and not undeservedly, as a warm stimulant and aperient. It strengthens the stomach, evacuates the intestinal canal, and promotes the natural secretion in general. Its continued use has frequently done much service in cachectic and icteric cases, uterine obstructions, and other similar disorders; particularly in cold, pale, phlegmatic habits. The dose may be from twenty drops to a tea-spoonful or more, twice or thrice a day.

TINCTURA ALOES VITRIOLATA, *vulgo* ELIXIR PROPRIETATIS VITRIOLATUM.

*Edinb.*

*Vitriolated Tincture of Aloes, commonly called Elixir Vitriolic Proprietatis.*

Take of

Myrrh,  
Socotrine aloes, of each an ounce and an half;  
English saffron, one ounce.

Digest the myrrh with the spirit for four days in a close vessel; then add the sassa and aloes

Digest again four days; and when the feces have subsided, pour off the tincture.

This tincture possesses the general properties of the preceding.

**TINCTURA AROMATICA, *five* CINNAMOMI COM-  
POSITA.**

*Famb.*

*Aromatic Tincture, or Compound Tincture of Cinnamon.*

Take of

- Cinnamon, six drams;
- Lesser cardamom seeds, one ounce;
- Garden angelica-root, three drams;
- Long pepper, two drams;
- Proof-spirit, two pound and an half.

Macerate for seven days, and filter the tincture.

This very warm aromatic is too hot to be given without dilution. A tea-spoon ul or two may be taken in wine, or any other convenient vehicle, in languors, weakness of the stomach, flatulencies, and other similar complaints.

**TINCTURA ASAFOETIDA.**

*Land.*

*Tincture of Asafoetida.*

Take of

- Asafoetida, four ounces;
- Rectified spirit of wine, two pints.

Digest with a gentle heat for six days; and strain.

**TINCTURA ASAFOETIDA, *vulgo* TINCTURA FOETIDA.**

*Famb.*

*Tincture of Asafoetida, commonly called Foetid Tincture.*

Take of

- Asafoetida, four ounces;
- Rectified spirit of wine, two pounds and an half.

Digest for six days; and strain.

This tincture possesses the virtues of the asafoetida itself; and may be given in doses of from ten drops to fifty or sixty.

TINCTURA AURANTII CORTICIS.

*Lond.*

*Tincture of Orange-Peel.*

Take of

Fresh orange-peel, three ounces ;

Proof spirit, two pounds.

Digest for three days ; and strain.

This tincture is an agreeable bitter, flavoured at the same time with the essential of the orange-peel.

TINCTURA BALSAMI PERUVIANI.

*Lond.*

*Tincture of the Balsam of Peru.*

Take of

Balsam of Peru, four ounces ;

Rectified spirit of wine, one pint.

Digest until the balsam be dissolved.

This tincture is at present but little employed, unless in composition, either under this or any other form.

TINCTURA BALSAMI TOLUTANI.

*Lond.*

*Tincture of Balsam of Tolu.*

Take of

Balsam of Tolu, one ounce and an half ;

Rectified spirit of wine, one pint.

Digest until the balsam be dissolved, and strain.

TINCTURA TOLUTANA.

*Edinb.*

*Tincture of Tolu.*

Take of

Balsam of Tolu, an ounce and half ;

Rectified spirit of wine, one pound.

Digest until the balsam be dissolved ; and then strain the tincture.

This solution of balsam of Tolu possesses all the virtues of the balsam itself. It may be taken internally, with the several intentions for which that balsam is proper, to the quantity of a tea-spoonful or two, in any convenient vehicle. Mixed with the plain syrup of sugar, it forms an elegant balsamic syrup.



## TINCTURA BENZOES COMPOSITA.

 *Lond.**Compound Tincture of Benzoin.*

Take of

Benzoin, three ounces;

Storax, Rhenish, two ounces;

Balsam of Tolu, one ounce;

Saccharine alcohol, half an ounce;

Rectified spirit of wine, two pints.

Digest with a gentle heat for three days, and strain.

TINCTURA BENZOINI COMPOSITA, vulgo BALSAMUM  
TRAUMATICUM. *Edinb.**Compound Tincture of Benzoin, commonly called Traumatic Balsam.*

Take of

Benzoin, three ounces;

Balsam of Peru, two ounces;

Hepatic aloes, half an ounce;

Rectified spirit of wine, two pounds.

Digest them in sand-heat for the space of ten days, and then strain the balsam.

The compound tincture of benzoin or traumatic balsam, stands highly recommended, externally, for cleansing and healing wounds and ulcers, for discussing cold tumours, allaying gouty, rheumatic, and other old pains and aches; and likewise internally, for warming and strengthening the stomach and intestines, expelling flatulencies, and relieving colicky complaints. Outwardly, it is applied cold on the part with a feather; inwardly a few drops are taken at a time, in wine, or any other convenient vehicle.

## TINCTURA CANTHARIDIS.

 *Lond.**Tincture of the Spanish Fly.*

Take of

Bruised cantharides, two drams;

Cochineal, powdered, half a dram;

Proof-spirit, one pint and an half.

Digest for eight days, and strain.

 *Edinb.*

Take of

Cantharides, one dram;

Proof-spirit, one pound.  
Digest for four days, and strain through paper.

The usual dose of these tinctures is from ten to twenty drops, which may be taken in a glass of water, or any other more agreeable liquor, twice a day; and increased by two or three drops at a time, according to the effect. The tincture of cantarides has of late been highly celebrated as a successful remedy in diabetic cases.

TINCTURA CARDAMOMI.

*Lond.*

*Tincture of Cardamom.*

Take of

Lesser cardamom-seeds, husked and bruised, three ounces;

Proof-spirit, two pints.

Digest for eight days, and strain.

*Edinb.*

Take of

Lesser cardamom seeds, four ounces;

Proof-spirit, two pounds and an half.

Macerate for eight days, and strain through paper.

Tincture of cardamoms has been in use for a considerable time. It is a pleasant, warm cordial; and may be taken, along with any proper vehicle, in doses of from a dram to a spoonful or two.

TINCTURA CARDAMOMI COMPOSITA.

*Lond.*

*Compound Tincture of Cardamom.*

Take of

Lesser cardamom-seeds, husked,

Caraway-seeds,

Cochineal, each, powdered, two drams;

Cinnamon bruised, half an ounce;

Raisins, stoned, four ounces;

Proof spirit, two pints

Digest for fourteen days, and strain.

This tincture contains so small a proportion of cardamoms as to be hardly entitled to derive its name from that article.

## TINCTURA CASCARILLÆ.

Lond.

*Tincture of Cascavilla.*

Take of

The bark of cascarilla, powdered, four ounces ;

Proof-spirit, two pints.

Digest with a gentle heat for eight days, and strain.

This tincture may be employed to answer most of those purposes for which the bark itself is recommended.

## TINCTURA CASTOREI.

Lond.

*Tincture of Castor.*

Take of

Rushia castor, powdered, two ounces ;

Proof-spirit, two pints.

Digest for ten days, and strain.

Edinb.

Take of

Rushia castor, an ounce and a half ;

Rectified spirit of wine, one pound.

Digest them for six days, and afterwards strain off the liquor.

The tincture of castor is recommended in most kinds of nervous complaints and hysteric disorders : the dose is from twenty drops to forty, fifty, or more.

## TINCTURA CASTOREI COMPOSITA.

Edinb.

*Compound Tincture of Castor.*

Take of

Rushia castor, one ounce ;

Aloë, half an ounce ;

Spirit of ammonia, one pound.

Digest for six days in a close-stopped phial, and strain.

This composition is a medicine of real efficacy, particularly in hysterical disorders, and the several symptoms which accompany them.

## TINCTURA CATECHU.

Lond.

*Tincture of Catechu.*

Take of

Catechu, three ounces ;

Cinnamon, bruised, two ounces ;  
 Proof-spirit, two pints.  
 Digest for three days, and strain.

**TINCTURA CATECHU, *vulgo* TINCTURA JAPONICA.**  
*Edinb.*

*Tincture of Catechu, commonly called Japonic Tincture.*

Take of  
 Infissated juice of catechu, three ounces ;  
 Proof-spirit, two pounds and a half.  
 Digest for eight days, and strain.

This tincture is of service in all kinds of defluxions, catarrhs, loosenesses, uterine fluxes, and other disorders, where mild astringent medicines are indicated. Two or three tea-spoonfuls may be taken every now and then,

**TINCTURA CINNAMOMI.**

*Lond.*

*Tincture of Cinnamon.*

Take of  
 Cinnamon, bruised, one ounce and an half ;  
 Proof-spirit, one pint.  
 Digest for ten days, and strain.

*Edinb.*

Take of  
 Cinnamon, three ounces ;  
 Proof-spirit, two pounds and a half.  
 Macerate for eight days, and strain.

The tincture of cinnamon possesses the restringent virtues of the cinnamon, as well as its aromatic cordial ones.

**TINCTURA CINNAMOMI COMPOSITA.**

*Lond.*

*Compound Tincture of Cinnamon*

Take of  
 Cinnamon, bruised, six drams ;  
 Lesser cardamom-seeds, husked, three drams ;  
 Long pepper,  
 Ginger, of each, in powder, two drams ;  
 Proof-spirit, two pints.  
 Digest for eight days, and strain.

From the different articles which this tincture contains, it must necessarily be of a more hot and fiery nature than the former.

# TINCTURA COLUMBÆ.

*Lond.*

*Tincture of Columba.*

Take of

Columba root, powdered, two ounces and an half ;

Proof-spirit, two pints.

Digest for eight days, and strain.

*Edinb.*

Take of

Columba root, powdered, two ounces ;

Proof-spirit, two pounds.

Digest for eight days, and strain.

This tincture may be advantageously employed against bilious vomitings, and those different stomachic ailments, in which the columba has been found useful.

# TINCTURA CINCHONÆ, *five* CORTICIS PERUVIANI.

*Lond.*

*Tincture of Peruvian Bark.*

Take of

Peruvian bark, powdered, six ounces ;

Proof-spirit, two pints.

Digest with a gentle heat for eight days, and strain.

# TINCTURA CORTICIS PERUVIANI.

*Edinb.*

*Tincture of Peruvian Bark.*

Take of

Peruvian bark, four ounces ;

Proof-spirit, two pounds and a half.

Digest for ten days, and strain.

This tincture may be given in doses of from a tea-spoonful to half an ounce, or an ounce, according to the different purposes it is intended to answer.

# TINCTURA CINCHONÆ, *five* CORTICIS PERUVIANI COMPOSITA.

*Lond.*

*Compound Tincture of Peruvian Bark.*

Take of

Peruvian bark, powdered, two ounces ;

Exterior peel of Seville oranges, dried, one ounce and an half;  
 Virginian snake-root, bruised, three drams;  
 Saffron, one dram;  
 Cochineal, powdered, two scruples;  
 Proof-spirit, twenty ounces.

Digest for fourteen days, and strain.

As a corroborant and stomachic it is given in doses of two or three drams: but when employed for the cure of intermittents, it must be taken to a greater extent.

TINCTURA CINCHONÆ, *five* CORTICIS PERUVIANI  
 AMMONIATA.

*Lond.*

*Ammoniated Tincture of Peruvian Bark.*

Take of

Peruvian bark, powdered, four ounces;  
 Compound spirit of ammonia, two pints.

Digest them in a close vessel for ten days, and strain.

This composition seems unnecessary.

TINCTURA CROCI.

*Edinb.*

*Tincture of Saffron.*

Take of

English saffron, one ounce;  
 Proof-spirit, fifteen ounces.

After digesting them for five days, let the tincture be strained through paper.

TINCTURA FERRI MURIATI.

*Lond.*

*Tincture of Muriated Iron.*

Take of

The rust of iron, half a pound;  
 Muriatic acid, three pounds;  
 Rectified spirit of wine, three pints.

Pour the muriatic acid on the rust of iron in a glass vessel; and shake the mixture now and then during three days. Set it by that the feces may subside; then pour off the liquor; evaporate this to one pint, and when cold, add to it the vinous spirit.

TINCTURA FERRI, *vulgo* TINCTURA MARTIS.

*Edinb.*

*Tincture of Iron.*

Take of

The scales of iron, purified and powdered, three ounces;

Muriatic acid, as much as is sufficient to dissolve the powder.  
 Digest with a gentle heat; and the powder being dissolved, add ~~or~~  
 rectified spirit of wine as much as will make up the whole liquor two  
 pounds and a half.

From ten to twenty drops of either of the tinctures may  
 be taken twice or thrice a day, in any proper vehicle.

#### TINCTURA FERRI AMMONIACALIS.

*Lond.*

*Ammoniac Tincture of Iron.*

Take of

Ammoniacal iron, four ounces;

Proof spirit, one pint.

Digest and strain.

This is the old *tinctura florum martialium*.

#### TINCTURA GALBANI.

*Lond.*

*Tincture of Galbanum.*

Take of

Galbanum, cut in small pieces, two ounces;

Proof-spirit, two pints.

Digest with a gentle heat for eight days, and strain.

This tincture may be successfully employed in cases of  
 flatulence and hysteria, where its effects are immediately  
 required, particularly with those who cannot bear asa-  
 foetida.

#### TINCTURA GENTIANÆ COMPOSITA.

*Lond.*

*Compound Tincture of Gentian.*

Take of

Gentian root, sliced and bruised, two ounces;

Exterior dried peel of Seville oranges, one ounce;

Lesser cardamom seeds, husked and bruised, half an ounce;

Proof-spirit, two pints.

Digest for eight days, and strain.

#### TINCTURA AMARA, *five* GENTIANÆ COMPOSITA, *vulgo* ELIXIR STOMACHICUM.

*Edinb.*

*Bitter Tincture, or Compound Tincture of Gentian commonly called*  
*Stomachic Elixir.*

Take of

Gentian root, two ounces;

Seville orange-peel, dried, one ounce;  
 Canella alba, half an ounce;  
 Cochineal, half a dram;  
 Proof-spirit, two pounds and a half.  
 Macerate for four days, and strain through paper.

These are very elegant spirituous bitters.

**TINCTURA GUAIACI, vulgo ELIXIR GUAIA CINUM.**  
*Edinb.*

*Tincture of Guaiacum, commonly called Elixir of Guaiacum.*

Take of

Gum guaiacum, one pound;  
 Rectified spirit of wine, two pounds and a half.  
 Digest for ten days, and strain.

**TINCTURA GUAIACI.**  
*Lond.*

*Tincture of Guaiacum.*

Take of

Gum guaiacum, four ounces;  
 Compound spirit of ammonia, a pint and a half.  
 Digest for three days, and strain.

**TINCTURA GUAIACI AMMONIATA, vulgo ELIXIR**  
**GUAIA CINUM VOLATILE.**  
*Edinb.*

*Ammoniated Tincture of Guaiacum, commonly called Volatile Elixir of Guaiacum.*

Take of

Gum guaiacum, four ounces;  
 Distilled oil of saffrafas, half a dram;  
 Spirit of ammonia, a pound and a half.  
 Macerate for six days in a close vessel, and strain.

These are very elegant and efficacious tinctures; the volatile spirit excellently dissolving the gum, and at the same time promoting its medicinal virtue. In rheumatic cases, a tea, or even table, spoonful, taken every morning and evening in any convenient article, particularly in milk, has proved of singular service.

**TINCTURA HELLEBORI NIGRI.**  
*Lond.*

*Tincture of Black Hellebore.*

Take of

Black hellebore-root, in coarse powder, four ounces;



Cochineal, powdered, two scruples;

Proof-spirit, two pints.

Digest with a gentle heat for eight days, and strain.

# **TINCTURA MELAMPODII, frus HELLEBORI NIGRI.**

*Edinb.*

*Tincture of Melampodium, or Black Hellebore,*

**Take of**

Black hellebore root, four ounces;

Cochineal, half a dram;

Proof-spirit, two pounds and a half.

Digest for eight days, and filter the tincture through paper.

This tincture has been found, from experience, particularly serviceable in uterine obstructions: in sanguine constitutions, where chalybeates are hurtful, it seldom fails of exciting the menstrual evacuations, and removing the ill consequences of their suppression. A tea-spoonful of the tincture may taken twice a day in warm water, or any other convenient vehicle.

# **TINCTURA JALAPII.**

*Lond.*

*Tincture of Jalap:*

**Take of**

Powdered jalap root, eight ounces;

Proof-spirit, two pints.

Digest with a gentle heat for eight days, and strain.

# **TINCTURA JALAPÆ.**

*Edinb.*

*Tincture of Jalap.*

**Take of**

Jalap, in coarse powder, three ounces;

Proof-spirit, fifteen ounces

Digest them for eight days, and strain the tincture.

# **TINCTURA KINO.**

*Edinb.*

*Tincture of Gum Kino.*

**Take of**

Gum kino, two ounces;

Proof-spirit, a pound and an half.

Digest eight days, and strain.

This is one of the best forms under which it can be exhibited in obstinate diarrhœas, and in cases of lenteria.

SPIRITUS LAVENDULÆ COMPOSITA.

*Lond.*

*Compound Spirit of Lavender.*

Take of

- Spirit of lavender, three pints;
- Spirit of rosemary, one pint;
- Cinnamon, bruised,
- Nutmeg, bruised, of each half an ounce;
- Red saunders, one ounce.

Digest for ten days, and strain.

SPIRITUS LAVENDULÆ COMPOSITUS.

*Lond.*

*Compound Spirit of Lavender.*

Take of

- Simple spirit of lavender, three pounds;
- Simple spirit of rosemary, one pound;
- Cinnamon, one ounce;
- Cloves, two drams;
- Nutmeg, half an ounce;
- Red saunders, three drams.

Macerate seven days, and strain.

These spirits are grateful reviving cordials, and have been long holden in great esteem, under the name of Palsy Drops, in all kinds of languors, weakness of the nerves, and decays of the aged.

TINCTURA MOSCHI.

*Edinb.*

*Tincture of Musk.*

Take of

- Musk, two drams;
- Rectified spirit of wine, one pound.

Digest for ten days, and strain.

TINCTURA MYRRHÆ.

*Lond.*

*Tincture of Myrrh.*

Take of

- Myrrh, bruised, three ounces;
- Proof spirit a pint and an half;
- Rectified spirit of wine, half a pint.

Digest with a gentle heat for eight days, and strain.

## TINCTURA MYRRHÆ.

*Edinb.**Tincture of Myrrh.*

Take of

Myrrh, three ounces;

Proof-spirits, two pounds and a half.

After digestion for ten days, strain off the tincture.

Tincture of myrrh is recommended internally for warming the habit, strengthening the solids, opening obstructions, and resisting putrefaction. The dose is from fifteen drops to forty or more.

## TINCTURA OPII.

*Lond.**Tincture of Opium.*

Take of

Hard purified opium, powdered, ten drams;

Proof-spirit, one pint.

Digest for ten days, and strain.

TINCTURA OPII, *five* THEBAICA, *vulgo* LAUDANUM  
LIQUIDUM.*Edinb.*

*Tincture of Opium, or Thebaic Tincture, commonly called Liquid Laudanum.*

Take of

Opium, two ounces;

Proof-spirit, two pounds.

Digest four days, and strain off the tincture.

## TINCTURA OPII CAMPHORATA.

*Lond.**Camphorated Tincture of Opium.*

Take of

Hard purified opium,

Flowers of benzoin, of each one dram;

Camphor, two scruples;

Oil of aniseed, one dram;

Proof-spirit, two pints

Digest for ten days, and strain.

TINCTURA OPII AMMONIATA, *vulgo* ELIXIR  
PAREGORICUM.*Edinb.*

*Ammoniated Tincture of Opium, commonly called Paregoric Elixir.*

Take of

Acid of benzoin,

English saffron, of each three drams ;  
Opium, two drams ;  
Distilled oil of aniseeds, half a dram ;  
Spirit of ammonia, sixteen ounces.

Digest four days in a close vessel, and strain.

This tincture contributes to allay the tickling which provokes frequent coughing ; and at the same time is supposed to open the breast, and give greater liberty of breathing : the opium procures a temporary relief from the symptoms, while the other ingredients tend to remove the cause, and prevent their return. It is given to children against the chincough, &c. in doses of from five drops to twenty ; to adults from twenty to an hundred.

TINCTURA RHABARBARI.

*Lond.*

*Tincture of Rhubarb.*

Take of

Rhubarb, sliced, two ounces ;  
Lesser cardamom seeds, bruised, half an ounce ;  
Saffron, two drams ;  
Proof-spirit, two pints.

Digest for eight days, and strain.

TINCTURA RHEI.

*Edinb.*

*Tincture of Rhubarb.*

Take of

Rhubarb, three ounces ;  
Lesser cardamom seeds, half an ounce ;  
Proof-spirit, two pounds and a half.

Digest for seven days, and strain.

TINCTURA RHABARBARI COMPOSITA.

*Lond.*

*Compound Tincture of Rhubarb.*

Take of

Rhubarb, sliced, two ounces ;  
Ginger, powdered,  
Saffron, each two drams ;  
Liquorice-root, bruised, half an ounce ;  
Distilled water, one pint ;  
Proof spirit, twelve ounces by measure.

Digest for fourteen days, and strain.

## TINCTURA RHEI AMARA.

*Edinb.**Bitter Tincture of Rhubarb.*

Take of

Rhubarb, two ounces ;  
 Gentian-root, half an ounce ;  
 Virginian snake-root one dram ;  
 Proof-spirit, two pounds and a half.

Digest for seven days, and strain.

## TINCTURA RHEI DULCIS.

*Edinb.**Sweet Tincture of Rhubarb.*

It is made by adding to the strained tincture of rhubarb, four ounces of  
 sugar-candy.

All the foregoing tinctures of rhubarb are designed as  
 stomachics and corroborants, as well as purgatives. In  
 weaknesses of the stomach, indigestion, laxity of the in-  
 testines, diarrhoeas, colic, and other similar complaints,  
 these medicines are frequently of great service.

TINCTURA RHEI CUM ALOE, *vulgo* ELIXIR SACRUM.*Edinb.**Tincture of Rhubarb with Aloes, commonly called Sacred Elixir.*

Take of

Rhubarb, ten drams ;  
 Socotorine aloes, six drams ;  
 Lesser card-mom seeds, half an ounce ;  
 Proof-spirit, two pounds and a half.

Digest for seven days, and strain.

This preparation is very much employed as a warming  
 cordial purge.

## TINCTURA SABINÆ COMPOSITA.

*Lond.**Compound Tincture of Savin.*

Take of

Extract of savin, one ounce ;  
 Tincture of castor, one pint ;  
 Tincture of myrrh, half a pint.

Digest till the extract of savin be dissolved, and then strain.

This preparation may be given in doses of from five  
 drops to twenty or thirty, or more, in penny-royal water,  
 or any other suitable vehicle.

TINCTURA SCILLÆ.

*Lond.*

*Tincture of Squill.*

Take of

Squilla, fresh dried, four ounces;

Proof spirit, two pints.

Digest for eight days, and pour off the liquor.

TINCTURA SENNÆ.

*Lond.*

*Tincture of Senna.*

Take of

Senna, one pound;

Caraway-seeds, bruised, one ounce and an half;

Lesser cardamom-seeds, bruised, half an ounce;

Rauis, stoned, sixteen ounces;

Proof spirit, one gallon.

Digest for fourteen days, and strain.

TINCTURA SENNÆ COMPOSITA, *vulgo* ELIXIR  
SALUTIS.

*Edinb.*

*Compound Tincture of Senna, commonly called Elixir of Health.*

Take of

Senna leaves, two ounces;

Jalap root, one ounce;

Coriander seeds, half an ounce;

Proof spirit, three pounds and half.

Digest for seven days, and to the strained liquor add four ounces of  
sugar-candy

Both these tinctures oftentimes relieve flatulent complaints and colics, where the common cordials have little effect: the dose is from one to two ounces.

TINCTURA SERPENTARIÆ.

*Lond.*

*Tincture of Snake root.*

Take of

Virginian snake root, three ounces;

Proof spirit, two pints.

Digest for eight days, and strain.

*Edinb.*

Take of

Virginian snake root, two ounces;

Cochineal, one dram ;  
 Proof-spirit, two pounds and a half.  
 Digest for four days, and then strain the tincture.

This tincture may be taken to the quantity of a spoonful or more every five or six hours ; and to this extent it often operates as a useful diaphoretic.

#### TINCTURA VALERIANÆ.

*Lond.*

*Tincture of Valerian.*

Take of

The root of wild valerian, in coarse powder, four ounces ;  
 Proof-spirit, two pints.  
 Digest with a gentle heat for eight days, and strain.

This tincture proves of a deep colour, and considerably strong of the valerian, though it has not been found to answer so well in the cure of epileptic disorders as the root in substance, exhibited in the form of powder, or-bolus. The dose of this tincture is from half a spoonful to a spoonful or more, twice or thrice a day.

#### TINCTURA VALERIANÆ AMMONIATA.

*Lond.*

*Ammoniated Tincture of Valerian.*

Take of

The root of wild valerian, in coarse powder, four ounces ;  
 Compound spirit of ammonia, two pints.  
 Digest for eight days, and strain.

#### TINCTURA VALERIANÆ AMMONIATA, *vulgo* TINCTURA VALERIANÆ VOLATILIS.

*Edinb.*

*Ammoniated Tincture of Valerian, commonly called Volatile Tincture of Valerian.*

Take of

Wild valerian root, two ounces ;  
 Spirit of ammonia, one pound  
 Macerate for six days in a close vessel, and strain.

The dose may be a tea-spoonful or two.

#### TINCTURA VERATRI, *five* HELLEBORI ALBI.

*Edinb.*

*Tincture of Veratrum, or White Hellebore.*

Take of

White hellebore root. eight ounces :

Proof-spirit, two pounds and a half.  
Digest them together for ten days, and filter through paper.

This tincture is sometimes used for acuating cathartics, &c. and as an emetic in apoplectic and maniacal disorders. It may likewise be so managed as to prove a powerful alterative and deobstruent, in cases where milder remedies have little effect; but a great deal of caution is requisite in its use: the dose, at first, ought to be only a few drops; if considerable, it proves violently emetic or cathartic.

ACIDUM VITRIOLI AROMATICUM, *vulgo* ELIXIR  
ELIXIR ACIDUM.

*Ednb.*

*Aromatic Acid of Vitriol, commonly called Acid Elixir of Vitriol.*

Take of

Rectified Spirit of wine, two pounds;

Drop into it by little and little six ounces of vitriolic acid; digest the mixture with a very gentle heat in a close vessel for three days, and then add of

Cinnamon, an ounce and a half;

Ginger, one ounce.

Digest again in a close vessel for six days, and then filter the tincture through paper in a glass funnel.

This is a valuable medicine in weakness and relaxations of the stomach, and decays of constitution, particularly in those which proceed from irregularities, which are accompanied with slow febrile symptoms, or which follow the suppression of intermittents. It frequently succeeds after bitters and aromatics by themselves had availed nothing.

SPIRITUS ÆTHERIS VITRIOLICI AROMATICUS,  
*vulgo* ELIXIR VITRIOLI DULCE.

*Edinb.*

*Aromatic Spirit of Vitriolic Ether, commonly called Sweet Elixir of Vitriol.*

This is made of the same aromatics, and in the same manner as the tinctura aromatica; except that, in the place of the vinous spirit, spirit of vitriolic ether is employed.

This is designed for persons whose stomachs are too weak to bear the foregoing acid elixir; to the taste it is gratefully aromatic, without any perceptible acidity.



## TINCTURA ZINZIBERIS.

*Lo. d.**Tincture of Ginger.*

Take of

Ginger, powdered, two ounces ;

Proof-spirit, two pounds.

Digest in a gentle heat for eight days, and strain.

This simple tincture of ginger is a warm cordial, and is rather intended as a useful addition, in the quantity of a dram or two, to purging mixtures.

## TINCTURA COLOCYNTHIDIS.

*Succ.**Tincture of Colocynth.*

Take of

Colocynth, cut small, and freed from the seeds, one ounce ;

Aniseed, one dram ;

Proof-spirit, fourteen ounces.

Macerate for three days, and strain through paper.

In this tincture we have the active purgative power of the colocynth.

## TINCTURA QUASSIÆ.

*Succ.**Tincture of Quassia.*

Take of

Quassia, bruised, two ounces ;

Proof spirit, two pounds and an half.

Digest for three days, and then strain through paper.

Under this form it may be advantageously employed for answering different purposes in medicine.

## TINCTURA LACCÆ.

*Succ.**Tincture of Lac.*

Take of

Gum lac, powdered, one ounce ;

Myrrh, three drams ;

Spirit of scurvy-grass, a pint and an half.

Digest in a sand-heat for three days ; after which, strain off the tincture for use.

This tincture is principally employed for strengthening the gums, and in bleedings and scorbutic exulcerations of

TINCTURA NUCIS VOMICÆ.

*R. s.*

*Tincture of Nux Vomica.*

Take of

Nux vomica, an ounce and an half;

Proof-spirit, two pounds.

Digest for some days, and then strain it.

The nux vomica, a very active vegetable, has of late been introduced into practice for the cure of intermittents and of contagious dysentery.

TINCTURA SUCCINI.

*Succ.*

*Tincture of Amber.*

**R**

Take of

Yellow amber, powdered, one ounce;

Vinidic Ucer, four ounces

Digest for three days in a vessel, accurately closed, frequently shaking the vessel, and after this strain through paper.

This tincture has been recommended in a variety of affections, particularly those of the nervous kind, as hysterical and epileptic complaints. It may be taken in doses of from a few drops to the extent of a tea-spoonful in a glass of wine or any similar vehicle.

*Mixtures.*

MISTURA CAMPHORATA.

*Lond.*

*Camphorated Mixture.*

Take of

Camphor, one dram;

Rectified spirit of wine, a little;

Double refined sugar, half an ounce;

Boiling distilled water, one pint.

Rub the camphor first with the spirit of wine, then with the sugar; lastly, add the water by degrees, and strain the mixture.

Camphor, under the present form as well as that of emulsion, is very useful in fevers, taken to the extent of a table-spoonful every three or four hours.

## MISTURA CRETACEA.

*Lond.**Chalk Mixture.***Take of**

- Prepared chalk, one ounce ;
- Double-refined sugar, six drams ;
- Gum Arabic, powdered, one ounce ;
- Distilled water, two pints.

**Mix them.**

## POTIO CRETACEA.

*Edinb.**Chalk Potion.***Take of**

- Prepared chalk, one ounce ;
  - Purest refined sugar, half an ounce ;
  - Mucilage of gum arabic, two ounces ;
- Rub them together, and add by degrees,**
- Water, two pounds and an half ;
  - Spirit of cinnamon, two ounces.

This is a very elegant form of exhibiting chalk, and is an useful remedy in diseases arising from, or accompanied with, acidity in the primæ viæ. It is frequently employed in diarrhœa proceeding from that cause. The dose of this medicine requires no nicety. It may be taken to the extent of a pound or two in the course of a day.

## MISTURA MOSCHATA.

*Lond.**Musk Mixture.***Take of**

- Musk, two scruples ;
  - Gum arabic, powdered,
  - Double-refined sugar, of each one dram ;
  - Rose-water, six ounces by measure.
- Rub the musk first with the sugar, then with the gum, and add the rose-water by degrees.**

This was intended as an improvement upon the hysteric julep with musk of Bates.

## LAC AMYGDALÆ.

*Lond.**Almond Milk.***Take of**

- Sweet almonds, one ounce and an half ;

Double-refined sugar, half an ounce;  
 Distilled water, two pints.  
 Beat the almonds with the sugar; then rubbing them together, add  
 by degrees the water, and strain the liquor.

EMULSIO COMMUNIS.

*Edinb.*

*Common Emulsion.*

Take of

Sweet almonds, one ounce;  
 Common water, two pounds and a half.

Beat the blanched almonds in a stone mortar, and gradually pour on  
 them the common water, working the whole well together; then  
 strain off the liquor.

EMULSIO ARABICA.

*Edinb.*

*Arabic Emulsion.*

This is made in the same manner as the preceding; only adding, while  
 beating the almonds,  
 Mucilage of gum arabic, two ounces.

These liquors are principally used for diluting and ob-  
 tunding acrimonious humours, particularly in heat of  
 urine and stranguries arising either from a natural sharp-  
 ness of the juices, or from the operation of cantharides,  
 and other irritating medicines: in these cases they are  
 to be drunk frequently, to the quantity of half a pint or  
 more at a time.

EMULSIO CAMPHORATA.

*Edinb.*

*Camphorated Emulsion.*

Take of

Camphor, one scruple;  
 Sweet almonds, blanched, ten;  
 Double-refined sugar, one dram;  
 Water, six ounces.

This is to be made in the same manner as the common emulsion.

This is a much better preparation for exhibiting cam-  
 phor in a liquid form than the *mistura camphorata*.

LAC AMMONIACI.

*Lond.*

*Ammoniacum Milk.*

Take of

Ammoniacum, two drams;  
 Distilled water, half a pint.

Rub the gum-resin with the water, gradually poured on, until it becomes a milk.

In the same manner may be made a milk of asafœtida, and of the rest of the gum-resins.

The ammoniacum milk is used for promoting expectoration, in humoral asthmas, and coughs. It may be given to the quantity of two spoonfuls twice a day.

**SPIRITUS ÆTHERIS VITRIOLICI COMPOSITUS.**

*Lond.*

*Compound Spirit of Vitriolic Ether.*

Take of

Spirit of vitriolic ether, two pounds;

Oil of wine, three drams.

Mix them.

This has been highly extolled as an anodyne and antispasmodic medicine; and with these intentions it is frequently employed in medicine.

**SPIRITUS AMMONIÆ COMPOSITUS.**

*Lond.*

*Compound Spirit of Ammonia.*

Take of

Spirit of ammonia, two pints;

Essential oil of lemon,

————— nutmeg, of each two drams.

Mix them.

**SPIRITUS AMMONIÆ AROMATICUS, vulgo SPIRITUS SALINUS AROMATICUS.**

*Edinb.*

*Aromatic Spirit of Ammonia, commonly called Saline Aromatic Spirit.*

Take of

Spirit of ammonia, eight ounces;

Distilled oil of rosemary, one dram and a half.

Distilled oil of lemon-peel, one dram.

Mix them, that the oils may be dissolved.

The dose is from five or six drops to sixty or more.

**SPIRITUS AMMONIÆ SUCCINATUS.**

*Lond.*

*Succinated Spirit of Ammonia.*

Take of

Alcohol, one ounce;

Water of pure ammonia, four ounces by measure ;

Rectified oil of amber, one scruple ;

Sops, ten grains.

Digest the sops and oil of amber in the alcohol till they be dissolved ; then add the water of pure ammonia, and mix them by shaking.

The *sau de luce* is not only used with the view of making an impression on the nose, but is taken internally in the same cases of weakness and fainting. It has likewise of late been celebrated as a remedy for the bite of the rattle-snake, when used internally, and applied externally to the wounded part.

SPIRITUS CAMPHORATUS.

*Lond.*

*Camphorated Spirit.*

Take of

Camphor, four ounces ;

Rectified spirit of wine, two pints.

Mix them, so that the camphor may be dissolved.

SPIRITUS VINOSUS CAMPHORATUS.

*Edinb.*

*Camphorated Spirit of Wine.*

Take of

Camphor, one ounce ;

Rectified spirit of wine, one pound.

Mix them together, that the camphor may be dissolved.

It may also be made with a double, triple, &c. proportion of camphor.

These solutions of camphor are employed chiefly for external uses, against rheumatic pains, paralytic numbnesses, inflammations, for discussing tumours, preventing gangrenes, or restraining their progress.

OLEUM CAMPHORATUM.

*Edinb.*

*Camphorated Oil.*

Take of

Fresh olive oil, two ounces ;

Camphor, half an ounce.

Mix them, so that the camphor may be dissolved.

This is designed for external purposes, and is useful against burns, bruises, rheumatic pains, &c.

## EMULSIO OLEOSA SIMPLEX.

*Gen.**Simple Oily Emulsion.*

Take of

Almond oil, one ounce ;  
 Syrup of marshmallows, an ounce and a half ;  
 Gum arabic, half an ounce ;  
 Spring water, six ounces.

Mix, and make an emulsion according to art.

## EMULSIO OLEOSA VOLATILIS.

*Gen.**Volatile Oily Emulsion.*

Take of

Almond oil, an ounce and a half ;  
 Syrup of marshmallow, one ounce ;  
 Gum arabic, half an ounce ;  
 Volatile alkali, one dram ;  
 Spring water, seven ounces.

Mix them according to art.

This is often advantageously employed in cases of  
 cough, hoarseness, and similar affections.

## JULAPIUM ACIDUM.

*Gen.**Acid Julep.*

Take of

Weak vitriolic acid, three drams ;  
 Simple syrup, three ounces ;  
 Spring water, two pounds.

Mix them.

In this state the vitriolic acid is sufficiently diluted to  
 be taken with ease in considerable doses ; and it may thus  
 be advantageously employed in various affections.

## JULAPIUM ÆTHEREUM.

*Gen.**Ether Julep.*

Take of

Pure vitriolic ether, two scruples ;  
 Spring water, six ounces ;  
 Refined sugar, half an ounce.

Mix them according to art.

JULAPIUM SUCCINATUM.

*Gen.*

*Amber Julep.*

Take of

Tincture of amber, two drams;  
Refined sugar, half an ounce;  
Spring water, six ounces.

Mix them, according to art.

This mixture may often be advantageously employed for counteracting nervous affections, and answering those other purposes for which we have already mentioned that this article is had recourse to in practice.

MIXTURA SALINA.

*Succ.*

*Saline Mixture, or Julep.*

Take of

Fixed vegetable alkali, three drams;  
River water, half a pound.

To this lixivium add,

Lemon juice, half a pound, or as much as is sufficient to saturate the alkali;

Syrup of black currants, one ounce.

This mixture is frequently prescribed in febrile diseases as a means of promoting a slight discharge by the surface: for where the skin is parched with great increased heat, it generally operates as a gentle diaphoretic. It often also promotes a discharge by urine, and is frequently employed to restrain vomiting.

SOLUTIO MINERALIS ARSENICI.

*Mineral Solution of Arsenic.*

Take of

White arsenic, reduced to a subtile powder,  
Fixed vegetable alkali, each sixty-four grains;  
Distilled water, half a pint.

Put them into a florentine flask, and let this be placed in a sand-heat, so that the water may boil gently till the arsenic be completely dissolved; then add to the solution, when cold, half an ounce of spirit of lavender, and as much distilled water as to make the solution amount to a pint.

This mixture is given, according to the age and other circumstances of the patient, in doses of from two to



twenty drops, once, twice, or oftener, in the course of the day : and its use has been found to be attended with remarkable success, although with some patients even very small doses have been found to excite severe vomiting.

*External Applications.*

For external uses various combinations of the former classes of bodies are formed, and these consist either in the diffusion of such bodies in water or oil.

*Medicated Waters.*

Medicated waters are solutions of earthy or metallic substances, used only for topical application, in the form of lotion, injection, or gargle.

**AQUA ALUMINIS COMPOSITA.**

*Lond.*

*Compound Alum-Water.*

Take of

Alum,

Vitriolated zinc, of each half an ounce ;

Boiling distilled water, two pints.

Pour the water on the salts in a glass vessel, and strain.

This liquor is used for cleansing and healing ulcers and wounds ; and for removing cutaneous eruptions, the part being bathed with it hot three or four times a day.

**AQUA CUPRI AMMONIATI.**

*Lond.*

*Water of Ammoniated Copper.*

Take of

Lime-water, one pint ;

Sal ammoniac, one dram.

Let them stand together, in a copper vessel, till the ammonia be saturated with copper.

This water is at present pretty much used as a detergent of foul and obstinate ulcers, and for taking away specks or films in the eyes.

**AQUA LITHARGYRI ACETATI COMPOSITA.**

*Lond.*

*Compound Water of Acetated Litharge.*

Take of

Acetated water of litharge, two drams ;

Distilled water, two pints;  
Proof-spirit, two drams.  
Mix the spirit with the acetated water of litharge; then add the distilled water.

This liquor is of the same nature with the solution of *saccharum saturni*.

AQUA ZINCI VITRIOLATI CUM CAMPHORA.

*Lond.*

*Water of Vitriolated Zinc with Camphor.*

Take of

Vitriolated zinc, half an ounce;  
Camphorated spirit, half an ounce by measure;  
Boiling water, two pints.

Mix, and filter through paper.

This is used externally as a lotion for some ulcers, particularly those in which it is necessary to restrain a great discharge.

AQUA ZINCI VITRIOLATA, *vulgo* AQUA VITRIOLICA.

*Edin.*

*Vitriolated Water of Zinc, commonly called Vitriolated Water.*

Take of

Vitriolated zinc, sixteen grains;  
Water, eight ounces;  
Diluted vitriolic acid, sixteen drops.

Dissolved the vitriolated zinc in the water, and then, adding the acid, strain through paper.

Where the eyes are watery or inflamed, this solution of vitriolated zinc is a very useful application.

In the combinations which form the various ointments, cerates and plasters, fixed oil is the substance which is the base of the whole; and it receives adhesion or consistence from a mixture with certain of the bitumens or wax.

*Plasters.*

In forming a plaster, a greater degree of consistence is required than in any other form, and it should remain solid when cold, and be soft and pliable on a moderate heat, so as to adhere to the body, as well as to the substance in which it is spread. The consistence, however,

varies somewhat with the part of the body, being firmer and more adhesive for applying to the extremities than elsewhere; two parts of oil and two of wax to one of powder, forms a plaster of proper consistence; and these proportions may be varied according to the firmness required.

Plasters are often impregnated with vegetable substances by boiling, but no particular advantage is derived from this addition. They are more properly united with lead, by which their consistence is improved, and a proportion of warm water should be added during the boiling.

#### EMPLASTRUM AMMONIACI CUM HYDRARGYRO.

*Lond.*

*Ammoniacum Plaster with Quicksilver.*

Take of

Strained ammoniacum, one pound;

Purified quicksilver, three ounces;

Sulphurated oil, one dram, or what is sufficient.

Rub the quicksilver with the sulphurated oil until the globules disappear; then add, by a little at a time, the melted ammoniacum, and mix them.

This is a very well contrived mercurial plaster. The ammoniacum in general affords a good basis for the application of the mercury.

#### EMPLASTRUM CANTHARIDIS.

*Lond.*

*Plaster of Spanish Flies.*

Take of

Spanish flies, finely powdered, one pound;

Plaster of wax, two pounds;

Prepared hog's lard, half a pound.

Melting the plaster and lard, a little before they coagulate sprinkle in the flies, reduced to a very fine powder.

#### EMPLASTRUM CANTHARIDUM, vulgo VESICATORIUM.

*Edin.*

*Plaster of Spanish Flies, commonly called Blistering Plaster.*

Take of

Hog's lard,

Yellow wax,

White resin,

Cantharides, each equal weights.

Beat the cantharides into a fine powder, and add them to the other ingredients, previously melted, and removed from the fire.

Both these formulæ are very well suited to excite blisters.

EMPLASTRUM CERÆ COMPOSITUM.

*Lond.*

*Compound Wax-Plaster.*

Take of

Yellow wax,

Prepared mutton-suet, of each three pounds ;

Yellow resin, one pound.

Melt them together, and strain the mixture whilst it is fluid.

EMPLASTRUM SIMPLEX, *five* EMPLASTRUM CERÆUM.

*Edinb.*

*Simple, or Wax-Plaster.*

Take of

Yellow wax, three parts ;

Mutton suet,

White resin, each two parts.

Melt them together into a plaster.

This plaster had formerly the title of *emplastrum attrahens*, and was chiefly employed as a dressing after blisters, to support some discharge.

EMPLASTRUM CUMINI.

*Lond.*

*Cummin Plaster.*

Take of

Cummin seeds,

Cakaway seeds,

Bay-berries, of each three ounces ;

Burgundy pitch, three pounds ;

Yellow wax, three ounces.

Melt the pitch and wax together, and mix with them the rest of the ingredients, powdered, and make a plaster.

This plaster stands recommended as a moderately warm discutient ; and is directed by some to be applied to the hypogastric region, for strengthening the viscera, and expelling flatulencies.

**EMPLASTRUM ASÆFOETIDÆ, vulgo EMPLASTRUM  
ANTIHYSTERICUM.**

*Edinb.*

*Plaster of Asafœtida, commonly called Antihysterical Plaster.*

Take of

- Litharge plaster,
- Asafœtida, strained, each two parts ;
- Yellow wax,
- Strained galbanum, each one part.

Mix them melted with a gentle heat, and make them into a plaster.

This plaster is applied to the umbilical region, or over the whole abdomen, in hysteric cases ; and sometimes with good effect.

**EMPLASTRUM LADANI COMPOSITUM.**

*Lond.*

*Compound Ladanum Plaster.*

Take of

- Ladanum, three ounces ;
- Frankincense, one ounce ;
- Cinnamon, powdered,
- Expressed oil of mace, of each an ounce ;
- Essential oil of mint, one dram.

To the melted frankincense add first the ladanum, softened by heat ; then the oil of mace. Mix these afterwards with the cinnamon and oil of mint, and beat them together, in a warm mortar, into a plaster. Let it be kept in a close vessel.

This has been considered as a very elegant stomach-plaster.

**EMPLASTRUM LITHARGYRI.**

*Lond.*

*Litharge Plaster.*

Take of

- Litharge, in very fine powder, five pounds ;
- Olive oil, a gallon ;
- Water, two pints.

Boil them with a slow fire, constantly stirring until the oil and litharge unite, and have the consistence of a plaster. It will be proper to add more boiling water, if the water that was first added be nearly consumed before the end of the process.

EMPLASTRUM LITHARGYRI, *vulgo* EMPLASTRUM COMMUNE.

*Edinb.*

*Litharge Plaster, commonly called Common Plaster.*

Take of

Litharge, one part ;

Oil of olive, two parts.

Boil them, adding water, and constantly stirring the mixture till the oil and litharge be formed into a plaster.

These plasters, which have long been known under the name of *diachylon*, are the common application in excoriations of the skin, slight flesh wounds, and the like.

EMPLASTRUM LITHARGYRI COMPOSITUM.

*Lond.*

*Compound Litharge Plaster.*

Take of

Litharge-plaster, three pounds ;

Strained galbanum, eight ounces ;

Turpentine, ten drams ;

Frankincense, three ounces.

The galbanum and turpentine being melted with a slow fire, mix with them the powdered frankincense, and afterwards the litharge-plaster melted with a very slow fire, and make a plaster.

EMPLASTRUM GUMMOSUM.

*Edinb.*

*Gum Plaster.*

Take of

Litharge plaster, eight parts ;

Gum ammoniac, strained,

Strained galbanum,

Yellow wax, each one part.

Melt them together, and make them into a plaster.

Both these plasters are used as digestives and suppuratives.

EMPLASTRUM LITHARGYRI CUM HYDRARGYRO.

*Lond.*

*Litharge Plaster with Quicksilver.*

Take of

Litharge-plaster, one pound ;

Purified quicksilver, three ounces ;  
 Sulphurated oil, one dram, or what is sufficient.  
 Make the plaster in the same manner as the ammoniacum-plaster with quicksilver.

**EMPLASTRUM HYDRARGYRI, vulgo CÆRULEUM.**  
*Edinb.*

*Quicksilver or Mercurial Plaster, commonly called Blue Plaster.*  
 Take of

Olive oil,  
 White resin, each one part ;  
 Quicksilver, three-parts ;  
 Litharge plaster, six parts.

Melt the oil and resin together, and when this mixture is cold, let the quicksilver be rubbed with it till the globules disappear ; then add by degrees the litharge plaster, melted, and let the whole be accurately mixed.

These mercurial plasters are considered as powerful resolvers and discutients.

**EMPLASTRUM LITHARGYRI CUM RESINA.**  
*Lond.*

*Litharge Plaster with Resin.*

Take of

Litharge plaster, three pounds ;  
 Yellow resin, half a pound.

To the litharge plaster, melted with a very slow fire, add the powdered resin ; mix them well, and make a plaster.

**EMPLASTRUM RESINOSUM, vulgo EMPLASTRUM ADHÆSIVUM.**  
*Edinb.*

*Resinous Plaster, commonly called Sticking Plaster.*  
 Take of

Common plaster, five parts ;  
 White resin, one part,  
 Melt them together, and make a plaster.

These plasters are chiefly used as adhesives for keeping on other dressings.

**EMPLASTRUM PICIS BURGUNDICÆ COMPOSITUM.**  
*Lond.*

*Compound Burgundy-Pitch Plaster.*

Take of

Burgundy pitch, two pounds

## PHARMACY.

685

Ladanum, one pound ;  
Yellow resin,  
Yellow wax, of each four ounces ;  
Expressed oil of mace, one ounce.  
To the pitch, resin, and wax, melted together, add first the ladanum,  
and then the oil of mace.

This plaster is applied in weakness or pains of the head, to the temples, forehead, &c. and sometimes likewise to the feet.

### EMPLASTRUM SAPONIS.

*Lond.*

*Sope Plaster.*

Take of

Sope, half a pound ;  
Litharge plaster, three pounds.

Mix the sope with the melted litharge-plaster, and boil them to the thickness of a plaster.

### EMPLASTRUM SAPONACEUM.

*Edinb.*

*Saponaceous Plaster.*

Take of

Litharge plaster, four parts ;  
Gum plaster, two parts ;  
Castile sope, scraped, one part.

To the plasters, melted together, add the sope ; then boil for a little, so as to form a plaster.

These plasters have been supposed to derive a resolvent power from the sope.

### EMPLASTRUM THURIS COMPOSITUM.

*Lond.*

*Compound Frankincense Plaster.*

Take

Frankincense, half a pound ;  
Dragon's blood, three ounces ;  
Litharge plaster, two pounds.

This plaster had formerly in the London pharmacopœia the title of *emplastrum roborans*. Though far the most elegant and simple, it is as effectual for that purpose as any of the medicines of this kind.



**EMPLASTRUM LITHARGYRI COMPOSITUM, vulgo  
EMPLASTRUM ROBORANS.**

*Edinb.*

*Compound Litharge-Plaster, commonly called Strengthening Plaster.*

**Take of**

Litharge plaster, twenty-four parts;

White resin, six parts;

Yellow-wax,

Oil of olive, each three parts.

Burnt vitriolated iron, eight parts.

Grind the colcothar with the oil, and then add it to the other ingredients previously melted.

This plaster is laid round the lips of wounds and ulcers over the other dressings, for defending them from inflammation and a fluxion of humours.

**EMPLASTRUM de BELLADONNA.**

*Brun.*

*Deadly Nightsh. de Plaster.*

**Take of**

The juice of the recent herb of belladonna,

Lintseed oil, each nine ounces;

Yellow wax, six ounces;

Venice turpentine, six drams;

Powder of the herb of belladonna, two ounces.

Let them be formed into a plaster according to art.

There can be no doubt that the belladonna, externally applied, has a very powerful influence, both on the nerves and blood-vessels of the part; and thus it has very considerable effect both on the circulation and state of sensibility of the part.

**EMPLASTRUM ad CLAVOS PEDUM.**

*Dan.*

*Corn Plaster.*

**Take of**

Galbanum, dissolved in vinegar, and again inspissated, one ounce;

Pitch, half an ounce;

Diachylon, or common plaster, two drams.

Let them be melted together; and then mix with them:

Verdegris, powdered,

Sul ammoniac, each one scruple;

And make them into a plaster.

This plaster has been celebrated for the removal of corns, and for alleviating the pain which they occasion.

EMPLASTRUM *è* CONIO.

*Succ.*

*Hemlock Plaster.*

Take of

Yellow wax, half a pound ;

Olive oil, four ounces ;

Gum ammoniac, half an ounce ;

After they are melted together, mix with them

Powdered herb of hemlock, half a pound.

This plaster appears very well contrived, and the additional ingredients well chosen for assisting the efficacy of the hemlock.

EMPLASTRUM CORROSIVUM.

*Gen.*

*Corrosive Plaster.*

Take of

Corrosive sublimate of mercury, half a dram ;

Hog's lard, half an ounce ;

Yellow wax, two drams.

Mix them according to art.

There can be no doubt that the *hydrargyrus muriatus* here employed is a very powerful corrosive ; and there may be some cases in which it is preferable to other articles of the tribe of caustics.

EMPLASTRUM *è* FOENUGRÆCO, *vulgo de* MUCILAGINIBUS.

*Gen.*

*Plaster of Fenugreek, or of Mucilages.*

Take of

Fenugreek-seed, two ounces ;

Linseed-oil, warm, half a pound.

Infuse them according to art, and strain ; then,

Take of

Yellow wax, two pounds, and a half ;

Gum ammoniac, strained, six ounces ;

Turpentine, two ounces.

Melt the gum ammoniacum with the turpentine, and by degrees add the oil and wax melted in another vessel, so as to form a plaster.

This plaster, although still in esteem by some, is probably of no great value.

#### EMPLASTRUM *ex* HYOSCYAMO.

*Succ.*

*Henbane Plaster.*

This is directed to be prepared in the same manner as the emplastrum *à conio*, or hemlock plaster.

From the well known sedative power of this plant, as affecting the nervous energy of the part to which it is applied, we might reasonably conclude that good effects may be obtained from it when used under the form of plaster.

#### EMPLASTRUM PICEUM.

*Res.*

*Pitch Plaster.*

Take of

White resin, six ounces;

Ship pitch, seven ounces;

Yellow wax, five ounces.

Melt them, and form them into a plaster.

Pitch, applied externally, has been supposed to act on two principles, by its warmth and by its adhesive quality; particularly it has thus been found to produce a cure in cases of *tinea capitis*.

#### *Ointments and Liniments.*

Ointments are plasters of a less firm consistence, and by reducing a plaster by a greater addition of oil, to the consistence of honey, an ointment is formed by the farther addition a liniment.

In making ointments the fat and wax should first be melted by a gentle heat, then constantly stirred, and the dry ingredients sprinkled in indiscriminately till by heat the mixture experiences consistence.

UNGUENTUM ADIPIS SUILLÆ.

*Lond.*

*Ointment of Hog's Lard.*

Take of

Prepared hog's lard, two pounds;

Rose water, three ounces.

Beat the lard with the rose-water until they be mixed; then melt the mixture with a slow fire, and set it apart that the water may subside; after which pour off the lard from the water, constantly stirring until it be cold.

UNGUENTUM SIMPLEX.

*Edinb.*

*Simple Ointment.*

Take of

Olive oil, five parts;

White wax, two parts.

Both these ointments may be used for softening the skin and healing chaps. The last is, however, preferable, as being more steadily of one uniform consistence.

UNGUENTUM ex ÆRUGINE.

*Edinb.*

*Ointment of Verdegris.*

Take of

Resinous ointment, fifteen parts;

Verdegris, one part.

This ointment is used for cleansing sores, and keeping down fungous flesh. Where ulcers continue to run from a weakness in the vessels of the part, the tonic powers of copper promise considerable advantage.

UNGUENTUM CALCIS HYDRARGYRI ALBÆ.

*Lond.*

*Ointment of white Calx of Quicksilver.*

Take of

The white calx of quicksilver, one drachm;

Ointment of hog's lard, one ounce and a half.

Mix, and make an ointment.

**This**

This is a very elegant mercurial ointment, and frequently made use of in the cure of obstinate cutaneous affections.

# UNGUENTUM 2 CALCE ZINCI.

*Edinb.*

*Ointment of Calx of Zinc.*

Take of

Simple liniment, six parts;

Flowers of zinc, one part.

This ointment is chiefly used in affections of the eye, particularly in those cases where redness arises rather from relaxation than from active inflammation.

# UNGUENTUM CANTHARIDIS.

*Lond.*

*Ointment of the Spanish Flies.*

Take of

Spanish flies, powdered, two ounces;

Distilled water, eight ounces;

Ointment of yellow resin, eight ounces.

Boil the water with the Spanish flies to one half, and strain. To the strained liquor add the ointment of yellow resin. Evaporate this mixture in a water bath, saturated with sea-salt, to the thickness of an ointment.

# UNGUENTUM EPISPASTICUM ex INFUSIONE CANTHARIDUM.

*Edinb.*

*Epispastic Ointment from Infusion of Cantharides.*

Take of

Cantharides,

White resin,

Yellow wax, each one ounce;

Hog's lard,

Venice turpentine, each two ounces;

Boiling water, four ounces.

Infuse the cantharides in the water, in a close vessel, for a night; then strongly press out and strain the liquor, and boil it with the lard till the water be consumed; then add the resin, wax, and turpentine; and make the whole into an ointment.

These ointments, containing the soluble parts of the cantharides, uniformly blended with the other ingredi-

ents, are more commodious, and in general occasion less pain, though not less effectual with this intention than the compositions with the fly in substance.

UNGUENTUM EPISPASTICUM ꝰ PULVERI CANTHARIDUM.

*Epispastic Ointment, from Powder of Cantharides.*

*Edinb.*

Take of

Resinous ointment, seven parts;  
Powdered cantharides, one part.

This ointment is employed in the dressings for blisters intended to be made perpetual, as they are called, or to be kept running for a considerable time, which in many chronic, and some acute cases, is of great service.

UNGUENTUM CERÆ.

*Lond.*

*Wax Ointment.*

Take of

White wax, four ounces;  
Spermaceti, three ounces;  
Olive oil, one pint.

Stir them, after being melted with a slow fire, constantly and briskly until cold.

This ointment had formerly the title of

UNGUENTUM CERUSSÆ ACETATÆ.

*Lond.*

*Ointment of acetated Cerusse.*

Take of

Acetated cerusse, two drams;  
White wax, two ounces;  
Olive-oil, half a pint.

Rub the acetated cerusse, previously powdered, with some part of the olive-oil; then add it to the wax, melted with remaining oil. Stir the mixture until it be cold.

UNGUENTUM SATURNINUM.

*Edin.*

*Saturnine Ointment.*

Take of

Simple ointment, twenty parts;  
Sugar of lead, one part.

Both these ointments are useful coolers and desiccatives.

### UNGUENTUM $\epsilon$ CERUSSA *vulgo* ALBUM.

*Edin.*

*Ointment of Cerusse, commonly called White Ointment.*

Take of

Simple ointment, five parts ;

Cerusse, one part.

This is an useful, cooling, emollient ointment, in great service in excoriations and other similar frettings of the skin.

### UNGUENTUM ELEMI.

*Land.*

*Ointment of Elemi.*

Take of

Elemi, one pound ;

Turpentine, ten ounces ;

Mutton suet, prepared, two pounds ;

Olive oil, two ounces.

Melt the elemi with the suet ; and, having removed it from the fire, mix it immediately with the turpentine and oil, after which strain the mixture.

This ointment, perhaps best known by the name of Arcaus's Liniment, has long been in use for digesting, cleansing, and incarnating.

### UNGUENTUM HELLEBORI ALBI.

*Land.*

*Ointment of white Hellebore.*

Take of

The root of white hellebore, powdered, one ounce

Ointment of hog's lard, four ounces ;

Essence of lemons, half a scruple.

Mix them, and make an ointment.

White hellebore externally applied has long been celebrated in the cure of cutaneous affections.

UNGUENTUM HYDRARGYRI FORTIUS.

*Lond.*

*Stronger Ointment of Quicksilver.*

Take of

- Purified quicksilver, two pounds;
- Hog's lard, prepared, twenty-three ounces;
- Mutton suet, prepared, one ounce.

First rub the quicksilver with the suet and a little of the hog's lard, until the globules disappear; then add what remains of the lard, and make an ointment.

UNGUENTUM HYDRARGYRI MITIUS.

*Lond.*

*Weaker Ointment of Quicksilver.*

Take of

- The stronger ointment of quicksilver, one part;
- Hog's lard, prepared, two parts.

Mix them.

UNGUENTUM *ex* HYDRARGYRO, *five* CÆRULEUM.

*Edinb.*

*Quicksilver, or Blue Ointment.*

Take of

- Quicksilver,
- Mutton suet, each one part;
- Hog's lard, three parts.

Rub them carefully in a mortar till the globules entirely disappear.

These ointments are principally employed, not with a view to their topical action, but with the intention of introducing mercury in an active state into the circulating system.

UNGUENTUM HYDRARGYRI NITRATI.

*Lond.*

*Ointment of nitrated Quicksilver.*

Take of

- Purified quicksilver, one ounce;
- Nitrous acid, two ounces;
- Hog's lard, prepared, one pound.

Dissolve the quicksilver in the nitrous acid; and, whilst it is yet hot mix it with the hog's lard, previously melted, and now growing cold.



## UNGUENTUM CITRINUM.

*Edinb.**Yellow Ointment.*

Take of

Quicksilver, one ounce ;  
 Spirit of nitre, two ounces ;  
 Hog's lard, one pound.

Dissolve the quicksilver in the spirit of nitre, by digestion in a sand heat ; and, whilst the solution is very hot, mix with it the lard, previously melted by itself, and just beginning to grow stiff. Stir them briskly together, in a marble mortar, so as to form the whole into an ointment.

This affords us a very active ointment ; and as such it is frequently employed with success in cutaneous and other topical affections.

## UNGUENTUM PICIS.

*Lond.**Tar Water.*

Take of

Tar,  
 Mutton-suet, prepared, of each half a pound.  
 Melt them together, and strain.

## UNGUENTUM à PICE.

*Edinb.**Ointment of Tar.*

Take of

Tar, five parts ;  
 Yellow wax, two parts.

This has been successfully employed against some cutaneous affections, particularly those of domestic animals. At one time, as well as the black basilicon, it was a good deal employed as a dressing even for recent wounds.

## UNGUENTUM RESINÆ F. A

*Lond.**Ointment of yellow Resin*

Take of

Yellow resin,

Yellow wax, of each one pound ;

Olive oil, one pint.

Melt the resin and wax with a slow fire ; then add the oil, and strain the mixture whilst hot.

UNGUENTUM BASILICUM FLAVUM.

*Edinb.*

*Yellow Basilicon Ointment.*

Take of

Hog's lard, eight parts ;

White resin, five parts ;

Yellow wax, two parts.

These are commonly employed in dressings, for digesting, cleansing, and incarnating wounds and ulcers.

UNGUENTUM SAMBUCI.

*Lond.*

*Elder Ointment.*

Take of

Elder flowers, four pounds ;

Mutton suet, prepared, three pounds ;

Olive oil, one pint.

Boil the flowers in the suet and oil, first melted together, till they be almost crisp ; then strain with expression.

This ointment does not seem superior to some others which are much neater, and preparable at less expence.

UNGUENTUM SPERMATIS-CETI.

*Lond.*

*Ointment of Spermaceti.*

Take of

Spermaceti, six drams ;

White wax, two drams ;

Olive oil, three ounces.

Melt them together, over a slow fire, stirring them constantly and briskly until they be cold.

This had formerly the name of the White Liniment, and it is perhaps only in consistence that it can be considered as differing from the Unguentum Simplex.

## PHARMACY.

## UNGUENTUM SULPHURIS.

 *Lond.**Sulphur Ointment.*

Take of

Ointment of hog's lard, half a pound;

Flowers of sulphur, four ounces.

Mix them, and make an ointment.

UNGUENTUM  $\frac{1}{2}$  SULPHURIS, *five* ANTIPSORICUM. *Edin.**Ointment of Sulphur, or Antipsoric Ointment.*

Take of

Hog's lard, four parts;

Sulphur, beat into a very fine powder, one part.

To each pound of this ointment add,

Essence of lemons, or

Oil of lavender, half a dram.

Sulphur is a certain remedy for the itch, more safe than mercury.

## UNGUENTUM TUTIÆ.

 *Lond.**Tutty Ointment.*

Take of

Prepared tutty, one dram;

Ointment of spermaceti, what is sufficient.

Mix them so as to make a soft ointment.

UNGUENTUM  $\frac{1}{2}$  TUTIÆ. *Edin.**Ointment of Tutty.*

Take of

Simple liniment, five parts;

Prepared tutty, one part.

These ointments have long been celebrated, and are still much employed against affections of the eye. But they cannot, we imagine, be esteemed elegant.

**LINIMENTUM SIMPLEX.**

*Edin.*

*Simple Liniment.*

Take of

Olive oil, four parts;

White wax, one part.

This consists of the same articles which form the Unguentum Simplex.

**LINIMENTUM AMMONIÆ.**

*Lond.*

*Liniment of Ammonia,*

Take of

Water of ammonia, half an ounce;

Olive oil, one ounce and a half.

Shake them together in a phial, till they are mixed.

This has long been known in the shops under the title of Linimentum Volatile.

**LINIMENTUM AMMONIÆ FORTIUS.**

*Lond.*

*Stronger Liniment of Ammonia.*

Take of

Water of pure ammonia, one ounce;

Olive oil, two ounces.

Shake them together in a phial.

This article differs from the foregoing only in strength.

**LINIMENTUM CAMPHORÆ.**

*Lond.*

*Camphor Liniment.*

Take of

Camphor, two ounces;

Water of ammonia, six ounces;

Simple spirit of lavender, sixteen ounces.

Mix the water of ammonia with the spirit, and distil from a glass retort, with a slow fire, sixteen ounces. Then dissolve the camphor in the distilled liquor.

## LINIMENTUM SAPONIS.

*Lead.**Soap Liniment.*

Take of

Soap, three ounces;  
 Camphor, one ounce;  
 Spirit of rosemary, one pint.

Digest the soap in the spirit of rosemary until it be dissolved, and add to it the camphor.

This, though a less active and penetrating application than the preceding, is perhaps no less useful; and it is often successfully employed for external purposes against rheumatic pains, sprains, bruises, and similar complaints.

## UNGUENTUM ÆGYPTIACUM.

*Gen.**Ægyptian Ointment.*

Take of

Honey, one pound;  
 Strong vinegar, half a pound;  
 Verdegria, powdered, five ounces.

Let the ingredients be boiled together till the verdegria be dissolved, so that the ointment may have a due degree of thickness and a purple colour.

This preparation had formerly a place in our pharmacopœia's under the title of Mel Ægyptiacum.

## UNGUENTUM ANODYNUM.

*Gen.**Anodyne Ointment.*

Take of

Olive oil, ten drams;  
 Yellow wax, half an ounce;  
 Crude opium, one dram.

Mix them according to art, so as to form an ointment.

Opium, thus externally applied, will in some degree be productive of the same effect as when used under the form of the anodyne balsam.

UNGUENTUM ad CANCRUM EXULCERATUM.

*Riun.*

*Ointment for an ulcerated Cancer.*

**Take of**

The recently expressed juce of the ricinus, one pound  
Let it be exposed to the rays of the sun in a leaven vessel till it acquires  
the consistence of an oil, then to one pound of this inspersed  
juce, add

Calcined lead,

White precipitate of mercury, each one pound.

Let them be properly mixed

This acid application must possess a considerable degree of corrosive power. And in some cases of cancer, by the proper application of corrosives, much benefit may be done, provided their caustic quality is suited to the state of the sore.

UNGUENTUM DIGESTIVUM.

*R.s.s.*

*Digestive Ointment.*

**Take of**

Verice turpentine, one pound;

The yolks of eight eggs.

Mix them together, according to art.

This warm stimulating application is well suited to promote the suppurative inflammation.

UNGUENTUM HÆMORRHOIDALE.

*Hæmorrhoidal Ointment.*

**Take of**

Saturnine ointment, six drams;

Oil of hyoscyamus, obtained by boiling, two drams;

Camphor, powdered, two scruples,

Mix them into an ointment

The name affixed to this ointment expresses the purpose for which it is applied.

UNGUENTUM NERVINUM.

*Succ.*

*Nervine Ointment.*

**Take of**

Prepared mutton suet, eight ounces.

H h 2

After it is melted and removed from the fire, add to it

Oil of bays, one pound ;

Ætherial oil of turpentine, one ounce ;

Rectified oil of amber, half an ounce.

Let them be mixed and rubbed together till they form an ointment.

It furnishes a warm stimulating nervine application, which may be in some degree instrumental in restoring sense and motion to paralytic limbs.

#### UNGUENTUM *de* NICOTIANA.

*Dan.*

##### *Ointment of Tobacco.*

**Take of**

The leaves of tobacco, cut down, three pounds ;

Juice of tobacco, nine ounces ;

Hog's lard, a pound and a half.

Let them be macerated for the space of a night, and then boiled over a gentle fire till the humidity be consumed. Having strained the fluid obtained by expression, add to it

Resin, three ounces ;

Yellow wax, half an ounce ;

Powder of the root of birthwort, three ounces.

Mix them into an ointment.

It has been found, under proper management, to afford an effectual cure in obstinate cutaneous affections.

#### UNGUENTUM *de* STYRACE.

*Succ.*

##### *Ointment of Storax.*

**Take of**

Olive oil, a pound and a half ;

White resin,

Gum elemi,

Yellow wax, each seven ounces.

After they are melted together and strained, add

Liquid Storax, seven ounces.

Mix them together, and agitate the mixture till it concretes into an uniform ointment.

It has been much celebrated not only as a strengthening application to weakly children, but even for the removal of affections of the bones, as in cases of rachitis and the like.

UNGUENTUM SUPPURANS.

*Sac.*

*Suppurative Ointment.*

Take of

Yellow wax,  
Resin, each half a pound.

To these melted, add

Onion roasted under the ashes ;  
Honey, each two pounds and a half ;  
Black soap, half a pound.

Let them be gently boiled together till all the moisture be consumed, then strain the liquor, expressing it from the materials, and afterwards agitate it with a wooden pestle that it may unite into one uniform mass.

This ointment is applied with the intention of promoting suppuration.

It may supply the place either of the blistering plaster or ointment ; and there are cases in which it is preferable to either.

*Cerates*

Form an intermediate consistence between the plaster and ointment, and therefore require no separate consideration.

CERATUM SIMPLEX.

*Edin.*

*Simple Cerate.*

Take of

Olive oil, six parts ;  
White wax, three parts ;  
Spermaceti one part

Unite them according to art.

This differs from the simple ointment in containing a greater proportion of wax to the oil.

CERATUM CANTHARIDIS.

*Lond.*

*Cerate of Cantarides, or Spanish Flies.*

Take of

Cerate of spermaceti, softened with heat, six drams ;



Spanish flies, finely powdered, one dram.  
Mix them.

Under this form cantharides may be made to act to any extent that is requisite.

#### CERATUM LAPIDIS CALAMINARIS.

*Lord.*

*Calamine Cerate.*

Take of

Calamine, prepared,  
Yellow wax, of each half a pound ;  
Olive oil, one pint.

Melt the wax with the oil, and, as soon as the mixture begins to thicken, mix with it the calamine, and stir the cerate until it be cold.

#### CERATUM $\frac{1}{2}$ LAPIDE CALAMINARI.

*Edin.*

*Cerate of Calamine.*

Take of

Simple cerate, five parts ;  
Calamine prepared, one part.

These compositions are formed upon the cerate which Turner strongly recommends in cutaneous ulcerations and excoriations.

#### CERATUM LITHARGYRI ACETATI.

*Lord.*

*Cerate of acetated Litharge.*

Take of

Water of acetated litharge, two ounces and an half ;  
Yellow wax, four ounces,  
Olive oil, nine ounces,  
Camphor, half a dram

Rub the camphor with a little of the oil. Melt the wax with the remaining oil, and as soon as the mixture begins to thicken, pour in by degrees the water of acetated litharge, and stir constantly until it be cold ; then mix in the camphor before rubbed with the oil.

This application has been rendered famous by the recommendation of Mr. Goulard.

CERATUM RESINÆ FLAVÆ.

*Lond.*

*Cerate of yellow Resin.*

Take of

Ointment of yellow resin, half a pound;

Yellow wax, one ounce.

Melt them together, and make a cerate.

This had formerly the name of *Unguentum Citrinum*. It is in no other respect different from the yellow basilicum, or *Unguentum resinæ flavæ*, than being of a stiffer consistence, which renders it for some purposes more commodious.

CERATUM SAPONIS.

*Lond.*

*Soap Cerate.*

Take of

Soap, eight ounces;

Yellow wax, ten ounces;

Litharge, powdered, one pound;

Olive oil, one pint

Vinegar, one gallon.

Boil the vinegar with the litharge, over a slow fire, constantly stirring until the mixture unites and thickens; then mix in the other articles, and make a cerate.

This, notwithstanding the name, may rather be considered as another saturnine application than one whose activity depends upon soap.

CERATUM SPERMATIS CETI.

*Edinb.*

*Cerate of Spermaceti.*

Take of

Spermaceti, half an ounce;

White wax, two ounces;

Olive oil, four ounces.

Melt them together, and stir until the cerate be cold.

This had formerly the name of *Ceratum Album*, and it differs in nothing from the *Unguentum Spermaceti*.

## PHARMACY.

## CERATHUM LABIALIS.

*Repts.**Lip Salve.*

Take of

Olive oil, eighteen ounces;

White wax, one pound;

Spermaceti, an ounce and a half;

Oil of rhodium, half a dram.

Form a cerate, tinging it with alkanet, so as to give a red colour.

The name affixed to this cerate points out the use for which it is intended.

## CERÆI MEDICATI.

*Succ.**Bougies.*

Take of

Yellow wax, melted, one pound;

Spermaceti, three drams;

Vinegar of litharge, two drams.

Mix them, and upon removal from the fire immerse into the mixture slips of linen, of which bougies are to be formed according to the rules of art.

These may also be made with double, triple, or quadruple, the quantity of the vinegar.

Bougies are a preparation of great importance to the surgeons, and deserve, therefore, a place.

END OF THE THIRD VOLUME.









